SEVENTY-FOURTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXIX.
NUMBER 14

NEW YORK, OCTOBER 5, 1918

10 CENTS A COPY
$4.00 A YEAR

The Temple of the Gods in Utah

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ONE of the most remarkable formations to be found in our wonderful southwestern country is the little known Temple of the Gods in southern Utah. Distant from any railway and off the main traveled roads, it has long remained hidden in the Sevier National Forest. The simplest way of approach is by a branch of the Denver and Rio Grande Railroad, which wanders southward through the central valleys of Utah, reaching at last the little village of Marysvale where an auto may be secured for the uphill climb of 55 miles through the mountains to Panguitch. Here is located the headquarters of the Forest Supervisor, who will direct one for the remaining 25 miles, part of which is over meadows where it is just possible to drive a car.

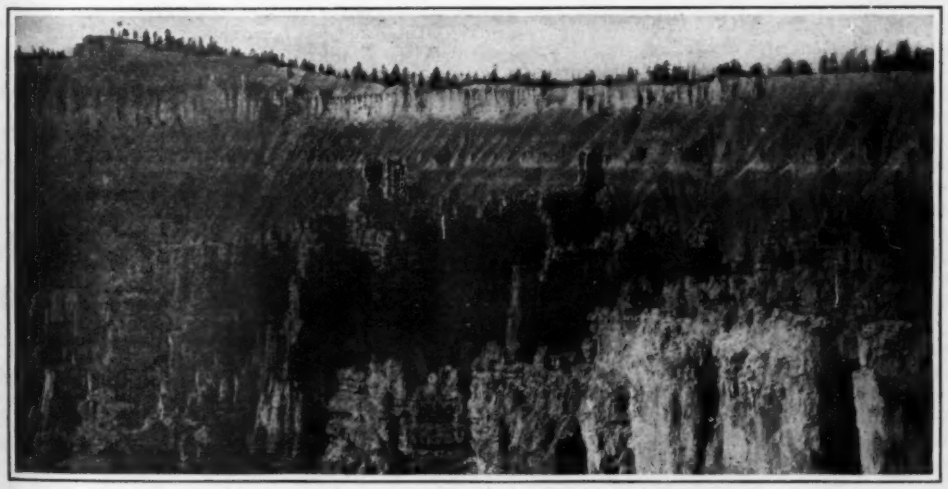
Perhaps the most interesting, and certainly the most difficult route to the formation is one which we recently traversed in the heat of midsummer. Leaving the north side of the Grand Canyon of the Colorado at Bright Angel Point we made a rapid run through the yellow pine and aspen forest of the Kaibab Plateau in northern Arizona, crossed the burning sands of the Kanab Desert, and reached the town of Kanab which nestles verdantly among the vermillion cliffs of southern Utah. We had come 80 to 85 miles before sundown and were ready for a similar journey to Panguitch on the following day. As all supplies that reach this country have to come by the route we were following we supposed the roads would be passable, but at frequent intervals we had to lift and push our car uphill through the deep sand. When it rains in this region all traffic is suspended for days by the impassable mud. As we work our way northward, the red cliffs are succeeded by white, and from the hamlet of Hatch, vivid pink cliffs hold the eye for many a mile to Panguitch. Over the road beyond to Marysvale, rapid travel is possible.

No traveler who finds himself in Panguitch should omit a visit to the Temple of the Gods. We could learn of no one who knew the way save the Forester, and we found it wholly unmarked, but eventually this interesting region will be often visited, for it combines a wealth of color with the most unusual forms. Here are great hillsides composed of limestone, clay and gravel which have been eroded into fantastic towers 25 to 400 feet in height, some of them isolated and others linked together in companies. So symmetrical are these ribbed and fluted pillars that they seem almost to have been turned with a lathe, and they often resemble kiosks or taper to minarets. But it is not merely this unique sculpturing that attracts and holds the attention, but especially is it their unusual coloring, for the temples are banded with red and salmon and yellow that is mixed with pink, while many of the spires are tipped with white. In the morning light the whole scene is bathed in orange and yellow, at noon it is flushed with rosy pink; while at evening from the canyon depths the temples glow with opalescent hues.

The pink towers and battlements of Bryce's Canyon

Two great hillsides have been eroded, separated by a ridge so low that the whole might be considered as one gigantic amphitheater, and, in fact, it is collectively known as Bryce Canyon. Looking across the largest or southern amphitheater toward the distant hillside we see as it were a vast city of prehistoric ruins; while, from the topmost bastion of the surrounding cliffs, we look down upon the stage setting of a fairy opera. Again we see a forest of pinnacles and tiny fingers, ghostly white, rising from the depths of the canyon like stalagmites. Far below is a labyrinth of narrow interlacing canyons leading to slopes dotted with pines and spruces whose green contrasts effectively with the orange-red of the canyon floor. Beyond are colored ridges and buttes that lead to the distant valley and the town of Tropic.

Sliding down the steep and treacherous slope of loose gravel we enter the gloom of a canyon only five or six feet wide, whose overhanging walls are several hundred feet in height. One may wander for hours in this maze of canyons studying the many colored walls and gazing upward at the narrow ribbon of blue sky; or he may explore the lower slopes amid the pines and the manzanita. From below the walls and towers have all the reality of castles, or elsewhere resemble the gigantic temples of India.



An extraordinary formation in the Temple of the Gods

View at the head of Bryce Canyon

Top of natural bridge in Sevier National Forest

SCIENTIFIC AMERICAN

Founded 1845

Published by Munn & Co., Inc., 233 Broadway, New York, Saturday, October 5, 1918

Charles Allen Munn, President
Orson D. Munn, Treasurer, both at 233 Broadway

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Will Tanks Win the War?

IF they are strikingly successful, all new and notable weapons of warfare are sure to be credited in the public mind with powers of destruction that they do not possess. Let a novel invention prove itself on the battlefield, and more often than not, it will be trumpeted abroad and headlined in the press as the final, decisive weapon of the war. These exaggerations are due to a lack of knowledge coupled with a lack of the sense of proportion. The majority see the world through a telescope; their field of vision is limited—just one little circle cut out of the whole horizon. Few there are who look out through the wide angle of vision with which God has endowed them, and see not only the thing which is the object of their immediate interest, but also many other similar things to right and left of it. The man with the telescopic eye takes in one thing at a time, and if he approves it and is pleased with it, more often than not he will acquire a greatly exaggerated sense of its value and importance.

But what has all this to do with tanks? Just this: that many people have become so obsessed with what the tank has done as to undervalue the long established military weapons, and predict that the tanks will win the war.

But tanks alone will not win the war, not even if they descend upon the enemy as the locusts upon the Egyptians of old. Nor will airplanes win the war, nor submarines, nor shells, nor machine guns, nor even poison gas. The war will be won by the harmonious and well adjusted coöperation of all these with properly trained and officered infantry and artillery, directed by a General Staff, and all under the supreme control of one man.

Now this is not written to depreciate the work of the tanks. On the contrary, they give promise of emerging from the war as the most important military invention of the whole struggle. They have been successful from the very first; and the small and fast types that have figured in the great counter offensive of this summer have greatly increased the reputation of the tank as a weapon of attack and pursuit.

For a gun to realize its fullest offensive efficiency, it must be supplied with mobility and protection—mobility, so that it may move up against the enemy, and protection so that its advance may not be stopped by the rifle and shellfire of the enemy. That was the problem which confronted the Allies, when they found themselves face to face with the murderous fire of German machine guns that were to be counted by the hundred thousand. The tank was the solution of the problem, and it proved itself at the great battle of the Somme in 1916, when it swept across No Man's Land ahead of the British troops, silencing the German machine-gun nests with its six-pounder shells and machine-gun fire and moving forward unharmed by the enemy bullets.

But there is a limit to the gunpower, protection and speed of the tank. Like the sea battleship or cruiser, its design is a matter of compromise. Some qualities must be sacrificed to others; otherwise the tank will be big and heavy beyond all reason. Thus, if a 6-inch gun were to be installed in the French tanks in place of the present 75-mm. or 3-inch piece, it would be necessary to reduce either the motive power or the ammunition and fuel supply, or use a lighter armor plate for protection. If the motive power and speed of the larger tanks were increased, or the armor protection doubled, there would have to be a reduction in the armament. Unless this compromise were made the weight would increase very rapidly. This is shown in the case of the German tanks, one of which was captured by the French during a counter attack of the past summer. The armor plate forming the front of this tank was 1¼ inches thick, the sides about five-eighths of an inch, and the rear plate was over three-quarters of an inch in thickness. The British tank was built of one-quarter-inch plate and weighed 30 tons; the German tank weighed 45 tons, an increase of fifty per cent.

The remarkable performance of the small "Whippets" and "Mosquitoes," brought into the western front by the British and French, would suggest that future development will be in the direction of smaller size and greater speed and mobility. So nimble were the Whippets that they were able to coöperate with the cavalry, the tanks advancing on the roads, flanked on either side by cavalry, which was deployed in the adjoining fields.

Perhaps the greatest service rendered by the new weapon was the reintroduction of the element of surprise in attack. General Byng before Cambrai, omitting the usual bombardment, rushed the barbed-wire defenses with a strong fleet of tanks, and opened gaps through which the infantry followed. Hitherto an attack in force had been heralded by a heavy bombardment. This gave the enemy time to rush his reinforcement to the threatened sector in sufficient numbers to prevent an absolute rupture of the line. Omitting the bombardment leaves the enemy in ignorance of the impending attack, and the tanks and infantry are through the first line before the enemy realizes that the fight is on.

The United States Army will be well equipped with tanks; in fact our tank service bids fair to become the *corps d'elite* of the whole army, rivalling the air service in popularity and in the high quality of its personnel. It has drawn to itself some of the finest material to be found in the whole army, and the tanks themselves will not only embody the experience of the British tanks as originally invented, and of the French, but they will contain many new features which have been developed as the result of much experimental work in the United States.

Food Facts versus Fallacies

IN an endeavor to show the good results of its operations, the Food Administration, the other day, gave out figures, showing the total and per capita expenditures for food in the United States during the past five quarters, itemized under nine major classifications. The per capita *food bill* was thus shown to have been 3½ per cent greater for the second quarter of 1918 than for the same period of 1917; and the claim was made that *food prices* in the United States, as a whole, have accordingly increased but 3½ per cent in the interval. The wide variance between this claim and individual experience has called out much comment; and in spite of our necessary tardiness, we wish to add our mite to the discussion.

If the Food Administration was going to compute our annual food bill, we have no quarrel with its action in basing its estimates on wholesale rather than retail prices. The former are more readily obtained and more accurately averaged—indeed, we should think that an effort to learn the total cost, to the ultimate consumer, of his food, must break down through lack of available data. And if the Food Administration was anxious to record its own achievements in the form of figures, the logical course was to confine itself to the wholesale market over which it has effective control.

But if we are able to agree with the Food Administration in its selection of the figures to be presented, we find it totally out of the question to follow it to the conclusions which it draws from these figures. Our food bill is one thing; the price of food is quite another. We should expect the exceptionally high-grade personnel of the Food Administration to realize that in the absence of data as to quantity bought, there is not the remotest connection between money spent and price paid.

It will not be disputed that the American diet has been profoundly modified as the result of war conditions and war prices. We eat differently, we waste less, many of us perforce eat less; and every act of voluntary or forced curtailment means so much less money spent for food. Yet the Food Administration's accountants tell us that this reduced expenditure is a mark of lower prices! On the same basis, if the price of wheat were to be tripled and consumption cut to one-third, they would have to assert that, since our wheat bill had shown no fluctuation, the price had remained the same, and that our impressions to the contrary were a delusion, created by local variations, and by hasty generalizations drawn from advances in other commodities!

The average consumer knows pretty well what he is paying for his goods; and the statement of September 23d must accordingly have visibly weakened the position of the Food Administration. This is a pity; because in stabilizing prices before prohibitive levels had been reached and in governing distribution and consumption, Mr. Hoover's bureau has done good work and lots of it—work which should get wider recognition than it has got. And it is even more a pity when we look into the figures closely enough to see that under proper interpretation they are most encouraging.

In spite of higher prices we spend less for sugar than we did. Our expenditures for meat have increased less sharply than have the prices, as every housewife knows them. Our bread bill has not kept pace with the price of wheat. Our bill for eggs has gone up much more rapidly than the price of eggs. And we spent, this summer, less than half as much for vegetables as we did last summer.

In the light of all this, the figures tell us that we have cut down consumption where this was possible, that we have eliminated wastes, that we have adopted substitutes freely. They tell us that we are growing in home gardens an unexpectedly large share of the vegetables we eat; yet the Food Administration statisticians, in keeping with their general argument, must actually maintain that vegetable prices have fallen 60 per cent since last summer!

The figures presented by Mr. Hoover, when properly interpreted, tell the story of how admirably the American people have responded to the call of wartime conditions, and of how well we are led in our campaign to feed the fight for democracy. This side of the case, however, has been here officially ignored, and the figures unwittingly made to tell a tale which is not in accord with the facts, and which is of minor consequence anyhow. In the face of the enterprise which we have in hand, we expect food prices to go up; and we do not care greatly how far they go, provided they do not go to a height which interferes with that enterprise. The statement of the Food Administration would be unfortunate enough, if the figures used in it had no particular true significance. It is made far more so by the circumstance that they possess such a significance, one of great interest and value, which has been lost in the shadow of a forced and false meaning.

Football Tactics on the Western Front

IT requires no great stretch of the imagination to establish a parallel between the tactics of General Foch in his victorious assault on the western front and the methods of a successful captain in the American game of football. The Allies took the ball from the Germans on the 18th of July, and from that day to this they have been bucking the center or making end runs with such speed and dash, and such bewilderment as to the next point of attack, that the enemy has been pressed steadily back until he is standing on his goal line, with all the world waiting in breathless expectation to see whether the Allies can call a touchdown behind the Hindenburg line before time is called by Father Christmas.

We all have known that, considered individually, the Allied team was made up of better material, with a keener temper to its courage, a finer faith in its heart, and an absolutely unconquerable determination to win out in the end whatever the odds might be. All that it lacked was a good captain and perfect team work, and just a dash of fresh, young blood thrown in from the side lines to raise the spirit and temper of the team to the high pitch with which it started this great game of war, now some four years ago.

Marshal Foch provided the captaincy, and our gallant young lads gave the needed inspiration to the tired but unbroken spirit of the veterans of the French and British armies. The result has been magical. When it looked as though the German mass play was going to break through, the Allies got the ball, and by a series of team plays that have never been surpassed, surely, in the history of the great game of war, they have kept it and carried it to the German line.

Of course, the great French marshal does not talk in the terms of the gridiron; but any one who is familiar with the famous works he has written on the art of war will realize that the fundamental principles upon which he works are not dissimilar to those of the successful football captain. He tells us that the general who has obtained the initiative should carefully nurse the battle along its whole front, and keep it alive until such time as he is ready for his great decisive attack. This is exactly what the Marshal is now doing; and it will be quite in accord with his principles to nurse the active offensive through the whole of the coming winter months, hitting the line now on this wing and now on that, and now at the center, in preparation for an overwhelming break through next spring and summer, when he will have from three to four million American troops at his disposal.

Is the pick of our Army to be utilized as the mass of maneuver, to use a military term, that is to say, as the swift and hard-hitting quarter back of the Allied team? If so, it is a pretty good guess that before the autumn leaves turn brown in 1919, the ball will be carried to the Rhine; and, if Germany wants yet another season's play, that 1920 will see it carried to Berlin.

British War Office Publishes a Technical Journal

IN connection with the *Daily Review* of the Foreign Press which has been issued by the General Staff of the British War Office during the war, supplements dealing with special subjects have been issued from time to time. Since last January there has been issued a fortnightly Technical Supplement, prepared with the coöperation of the Institution of Civil Engineers This was originally intended for official circulation only, but it has now been placed on sale and the numbers from May 28th onward may be purchased at six pence each through booksellers.

Naval and Military

Our Largest Shipbuilding Center.—The tenth shipbuilding district of the United States Shipping Board may well be called the Clyde of America. It includes Philadelphia, Chester, Camden and Gloucester and it is now in charge of Rear-Admiral Francis T. Bowles, the Assistant General Manager of the Emergency Fleet Corporation. Some idea of the magnitude of the shipbuilding activities in this district may be gathered from the fact that Admiral Bowles has general supervision in these Delaware yards of no less than 65,000 workers.

Ship Tonnage Completed in One Week.—A Washington despatch states that thirteen ships of all types of 55,000 tons deadweight, were completed and delivered to the Emergency Fleet Corporation during the week ending September 20th. The figures, as made public show there were six steel ships, of 31,400 tons capacity, and seven wooden and composite ships, aggregating 24,500 deadweight tons. Launchings during the week numbered 17, of a deadweight tonnage of 72,700. Among these were 11 steel ships, of 50,500 deadweight tons, and six wood and composite ships, of 22,200 tons.

Enlargement of Our Flying Fields.—With a view to giving more complete instruction and training in gunnery to American flyers previous to their crossing to Europe, the Government is leasing land adjoining the larger flying fields. Thus, a tract of 10,000 acres has been leased which lies just outside of Ft. Worth, Texas, and therefore within easy touch of the Taliaferro, Barron and Carruthers Fields. Fronting along the south shore and within a few miles of Hazelhurst Field, Mineola, L. I., a tract of 750 acres has been leased. This will be known as Lufberry Field. Also, 50 acres adjoining the Mineola Field have been leased and prepared as a drill and exercise ground.

The Shipping Situation.—The shipping situation, as lately made known by the Shipping Board, is as follows The total losses, Allied and Neutral, from August, 1914, to September 1st, 1918, are 21,404,913 deadweight tons. The total construction, Allied and Neutral, during the same period was 14,247,825 tons. The total enemy tonnage captured to the end of 1917 was 3,795,000. This shows an excess of losses over gains of 3,362,088 tons. The estimated normal increase in the world's tonnage, if the war had not occurred, would have been 14,700,000 tons. Adding this to the excess of losses over gains we arrive at a total net deficit, due to the war, of 18,062,088 tons. The Allied monthly construction exceeded the losses for the first time in May of the present year.

Substitute for Silk Powder Bags.—Chemically treated cotton cloth, we are informed by the *Army and Navy Journal* has been tested out by the Ordnance Department as a substitute for the silk used for making powder bags. The importance of this experiment is shown by the fact that if it is successful it will bring about a saving of money in the Ordnance program of about $30,000,000, and at the same time it will go some distance in meeting the serious shortage in silk. At present bags for the large powder charges used in heavy ordnance call for millions of yards of silk, and the scarcity of silk has caused an enormous increase in the price. Early in the war Germany used chemically-treated cotton; but the failing cotton supply has driven her to the use of still other substitutes.

Destroyer Gains and Losses.—Attention has been directed so largely to submarine losses, that the severe losses among destroyers have not attracted much notice; but they are heavy. Thus the destroyers of all the Allies lost from all causes during the four years of war are: for Great Britain, 58; France, 9; Italy, 5; United States, 2; and Japan, 2. This makes a total for the Allies of 76. During the same period, Premier Lloyd George tells us, the Germans lost 150 submarines, and this is generally believed to be about equal to their present total force. The enemy, therefore, has lost twice as many units as have the Allied destroyer forces that have been hunting him down. But the great superiority of the hunter over the hunted is shown by the fact that, while the Germans have lost 150 U-boats out of 300, the Allies have lost only 76 destroyers out of more than 1,000.

A Warning Against Optimism.—The lay readers of the best military writers who are engaged in making daily comments on the war, will have noticed that the majority of these are warning against an over-buoyant optimism based upon our recent fine successes against the German armies. Thus General Sir F. B. Maurice, a cautious and discriminating critic, who was at one time Director of Military Operations on the General Staff, reminds us that the "Allies as yet have no material superiority in numbers." He reminds us further that the troops which are being beaten back are after all only the "outposts or advance troops who occupy a belt of country of varying depth." This may have been true until the recent smashing in of the Hindenburg line with the switch line back of it. Here unquestionably Germany threw in masses of her best troops in the hope of averting a defeat which may ultimately turn out to have disastrous consequences.

Science

Hookworm in the Army.—A report of the Surgeon-General of the Army states that in two regiments recruited from two Gulf states, hookworm infection was found to the extent of 54 per cent in one command and 32 per cent in the other. It is significant that both regiments showed an unusually large mortality due to measles and to lung and bronchial troubles. Measles occurred two and a half times as frequently in men with hookworm as in those free from it. Measles patients suffering from hookworm were twice as likely to fall victims to pneumonia and kindred diseases.

Department of Agriculture Nitrogen Plant.—The U. S. Department of Agriculture announces that the largest experimental plant in the United States for the manufacture of fixed nitrogen from the air, with the exception of the plants in course of construction for the War Department, is now in operation at the Arlington experiment farm of the Department of Agriculture, near Washington. At this plant atmospheric nitrogen is combined with hydrogen to form ammonia, which is available for use in the manufacture of either explosives or fertilizer. The Haber process is used in the fixation of the nitrogen.

To Rid the World of Yellow Fever.—In the year 1916 Surgeon-General Gorgas headed a commission of the International Health Board which visited South America and delimited the seed-beds of yellow fever, as a preliminary step in a campaign for completely eliminating this disease from the world. It is believed that the sources of infection are at Guyaquil, Ecudaor; in a region along the south shore of the Carribean; in a strip along the north coast of Brazil; and in a certain area on the west coast of Africa. The progress of this ambitious undertaking has now been interrupted by the participation of the United States in the war, but work will be resumed as soon as conditions permit.

A School for Training Sanitarians.—The School of Hygiene and Public Health of Johns Hopkins University, which opens September, 1918, is probably destined to become a national and international center of research and instruction in the fields of preventive medicine and public health administration. The new school, which will be quite distinct from Johns Hopkins Medical School, was established with funds provided by the Rockefeller Foundation. The director is Dr. William H. Welch. Besides providing for full-time students, the school offers short intensive courses for the benefit of health officers in active service. The school is now in temporary quarters, but will have a fine new laboratory as its permanent home after the first of September, 1919.

Facts About Hay Fever.—The investigations of the American Hay Fever Prevention Association are shedding much light on problems connected with this disease. According to a recent article in the Public Health Reports, only about one per cent of the population is susceptible to the disease. The susceptibility of hay fever subjects varies widely, not only in their reaction to the different plant pollens that cause the disease, but also in the degree of this reaction. The majority of subjects in the eastern and southern states are sensitive to the pollen of the ragweeds and are therefore victims of the spring type of hay fever. A smaller number are susceptible to the effects of grass polen, and have the autumnal type of the disease. Others are sensitive to both (spring-autumn hay fever). About eight per cent are sensitive not only to ragweed and grass pollens, but also to the pollens of various other plants, including certain trees, and hence suffer from attacks during a great part of the year (perennial form). Some patients suffer only when the specific pollen is especially abundant in the air, others during the whole pollinating season of the plant.

A Hospital Ship for the Sulu Islands.—The problem of providing the hitherto unknown blessing of medical attendance for the natives of the Sulu Archipelago has been solved by putting in operation a small hospital ship and floating dispensary, the "Busuanga," which began her work last November. The ship is fitted with a modern operating-room, a 10-bed hospital ward, a pharmacy, and quarters for the crew and staff, including an American doctor, a Filipino assistant, a bacteriologist, an American chief nurse, and two native nurses. Besides rendering outpatient service, the staff performs emergency operations at each port of call. Cases which require hospital care are transported in the ship's ward to one of the base hospitals which have been established at Jolo and Zamboanga. The initial cost of this undertaking has been met with funds provided by the International Health Board, which will also contribute to the expense of maintenance for five years after which all expenses are to be borne by the Philippine government. A report on this enterprise points out the fact that it involves a principle which may have wide application; viz., that of mobile dispensaries operating from a base hospital. Thus a motor-car dispensary, with doctor and nurse, might operate through a rural area from a general hospital in a part of the United States now ill-provided with medical facilities.

Engineering

French Women Engineers.—Among the 340 students who have enlisted in the Ecole Centrale des Arts et Manufactures, says the *Le Génie Civil*, there are six young women who stand well in the class. It is believed that this number will increase considerably in succeeding years as women acquire a bent for engineering.

The New Railway Route to the Pacific.—The Government has approved of the completion of the San Diego and Arizona Railway connecting San Diego with the Southern Pacific at Yuma. At present there is a gap of 40 miles between Campo and Carriso Pass which has yet to be completed. Here the line will have to pass over a tall mountain barrier 3,657 feet high, which will call for much grading and tunneling. It is expected that the line will be completed early next year.

Concrete Shipbuilding at Singapore.—A concrete ferryboat is to be launched at Tanjong Rhu soon, according to the *Singapore Free Press*. This will be used by the Federated Malay States railways to ferry freight cars across to Johore. Concrete is being used owing to the present scarcity of steel. The boat is 125 feet long with a beam of 27 feet and a molded depth of 8 feet. It has a displacement of 500 tons. At the same place a large seagoing concrete boat of 2,500 tons deadweight is being constructed.

Pont Wilson—A New Arched Bridge In Lyons.—Work on a handsome stone bridge across the Rhone River at Lyons, France, was begun in October, 1912. At the outbreak of the war, the work was in a large measure retarded, but it has continued slowly since then and the bridge was brought to completion this summer. On Bastile day the new bridge was dedicated and named "Pont Wilson," in honor of our president. It is a four-arch bridge, with two additional approach arches, and is 743 feet long. The roadway is 36 feet wide, with a 15-foot sidewalk on each side.

Under the exigencies of war we are learning to pay more attention to repairs than we formerly did. The cobbler today is reaping a rich harvest from men who never used to think of having their shoes mended. The same is true of many other things, and in particular of machinery. The war has practically monopolized steel production and, in addition to this, there is a severe shortage of skilled labor. For this reason it is not so easy today to purchase a new casting when an old one is broken. This has furnished a field for welding apparatus, both of the acetylene and electric type; and manufacturers are coming to appreciate the convenience and efficiency of this method of joining broken steel and iron.

Letting the River Lay Its Own Revetment.—Owing to the severe erosion of the banks of the Colorado River near Needles, Cal., which threatened to wash away the Atchison, Topeka and Santa Fe Railway, timber cribs were laid along the banks of the river and filled with stone. The cribs were laid in two rows and were lashed together with wire cable and firmly anchored to posts set back 100 feet from the cribs. As the banks caved in under the action of the river, the outer row of cribs sank into the water and formed a protection for the banks, preventing further erosion. To keep the rocks from falling out of the cribs they were covered with a heavy wire mesh. This plan is reported to prove very successful in preventing the river from wearing away its banks.

Keeping Camps Free from Flies and Mosquitoes.—According to a recent statement of the War Department energetic measures have been taken to guard troops stationed in camps and cantonments from diseases carried by mosquitoes and flies, and, incidentally, the civilian population in the neighborhood will derive benefit therefrom. The division surgeon at each camp is assisted by a sanitary inspector, a sanitary engineer, and a detachment of from 100 to 200 enlisted men employed continually in sanitary work. Stagnant pools and streams are cleaned up, swamps drained, etc., or, if these measures are impracticable, the bodies of water are kept covered with oil. The U. S. Public Health Service is performing similar work in the surrounding country to a distance of one mile around all camps.

Spruce for Our Airplanes.—One of the large paper companies of the West owns extensive forestry lands in Oregon in which fine specimens of fir, spruce, cedar, and hemlock are to be found in abundance. When our Government found itself facing a shortage of spruce for airpalnes and fir for ships, this patriotic company placed its timber holdings at the disposal of the United States Government; and at its own expense undertook the task of opening one of the tracts in which there are 300,000,000 feet of timber available for war service. This involved the rebuilding of a railroad about four and a half miles long which was not adequate to endure the additional traffic that would be imposed upon it by the war demands. The work of reconstruction and extension, involving eight miles of new railway, was carried on through the winter despite heavy rainstorms which greatly retarded the work. On July 20 the first trains of spruce wended their way out of this timber tract.

Gunstocks

The Complicated Business of Supplying This Simple Part of Our Rifles

TO supply the demand for gunstocks for the millions of rifles needed for military purposes the whole country is being searched for good black walnut trees. No other wood is considered quite so well adapted to this purpose as the walnut as it combines the necessary strength, resilience, good cabinet qualities, and ability to retain its shape when exposed to the weather.

It was pretty generally supposed before the war started that the supply of walnut timber was about exhausted but when the big demand of our Allies came it was readily met. So great were the offerings at first that some of the big dealers had to call in their buyers for a time. More than three years' continuous demand for this wood not only for gunstocks but also for airplane propellers and veneers have materially reduced the supply but have by no means exhausted it.

Black walnut is one of the few trees for which every farmer has a high regard. He will encourage its growth and even plant it when other trees are looked upon as mere encumberers of the ground. In consequence there are few farms throughout the natural range of the tree where from one to many good walnut trees cannot be found. Now these are coming onto the market, much of it voluntarily and some of it virtually requisitioned by the Government. Stumpage prices of from $50 to $100 or even more per thousand board feet are being paid, depending upon the size and quality of the timber.

So far no shortage has been felt except locally due more to freight congestion and embargoes than to lack of material. But even if the supply of black walnut were suddenly cut off there would be no diminution in the supply of gunstocks. Other woods have already proved their acceptability for this purpose and in fact are now in extensive use. The best of these are the black and yellow birches, known commercially as red birch. It is estimated that there is a total of over 10 billion board feet of this timber standing in Michigan, Wisconsin and Minnesota, of which Michigan is credited with five billion, Wisconsin with 4¼ billion, and Minnesota with three-quarters of a billion feet. Since about three board feet are required to make a gunstock there is obviously no cause for alarm about the supply.

A gunstock is cut from clear planks which are a little over two inches thick. In producing them considerable material is produced which is less than this thickness. It is possible to use this by gluing two boards together. A manufacturer of sporting rifles and shotguns has used this method for years for a certain line and while there have been frequent returns on account of opening up along the joint it would appear that the trouble could be remedied. Much progress has been made recently in the proper manufacture and use of glues so that ply-wood and laminated construction is proving of merit for all sorts of exacting purposes not previously considered possible.

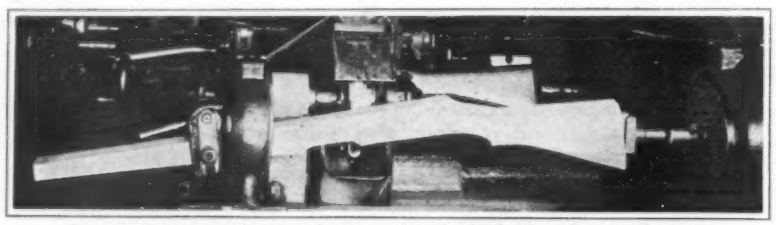
For smaller arms, such as the .22 sporting rifle, red gum has very largely replaced walnut thus cutting down on the demand for the more valuable wood. Figured gum rivals Circassian walnut in appearance and when treated with ammonia fumes the color is deepened and made still more attractive. The natural tendency of the wood to warp is overcome by modern methods of kiln-drying.

Before the war it was customary to season gunstock material in the form of blanks for from two to several years in open sheds. Only when they were thoroughly air-dried were they placed in the kilns to remove the final moisture before going to the lathes. The sudden demand for an enormous number of stocks of special size had to be met by the use of green material and one of the biggest problems confronting the manufacturer was the drying of the lumber. One concern tried to use the dry-kilns designed for thoroughly air-seasoned timber and the loss due to checking and splitting in some instances approached 50 per cent and averaged about twenty per cent.

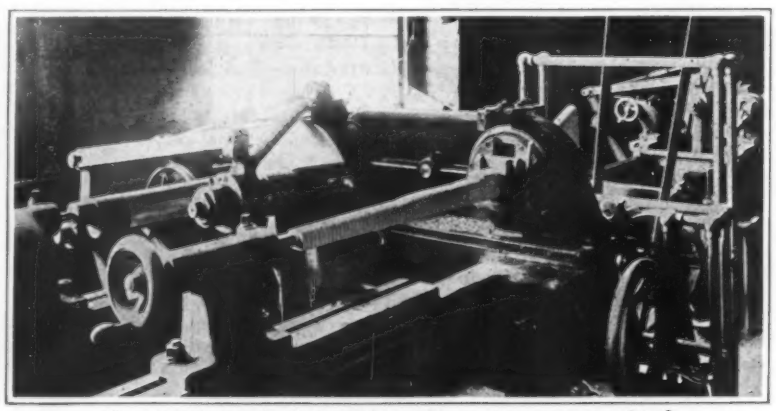
The trouble was that drying proceeded too rapidly from the start. When wood dries it shrinks and unless drying proceeds uniformly from the center of the stick to the outside a dry layer will be formed over a wet core. This outer shell becomes hardened and set in a state of tension, often checking and splitting. When the core dries it shrinks away from the hardened outer case and big cracks open up, sometimes tearing the wood to pieces and pulling it out of shape. The same thing results when some of the more refractory woods are seasoned too rapidly in the open air.

In the new type of kilns the hot air which is first admitted to the drying chamber is so moist that the wood is heated through and through before drying takes place. Then gradually the humidity of the air is reduced, the temperature raised, and drying proceeds at a rate which is so controlled that case-hardening and checking is almost entirely overcome. There are devices for the automatic regulation of the temperature and humidity, while the rate of drying and the condition of the material are daily determined by the inspection and weighing of samples placed in different parts of the kiln. The results are plotted on a chart from which the condition of the wood in each kiln can be noted at a glance. The humidity and temperature are automatically registered.

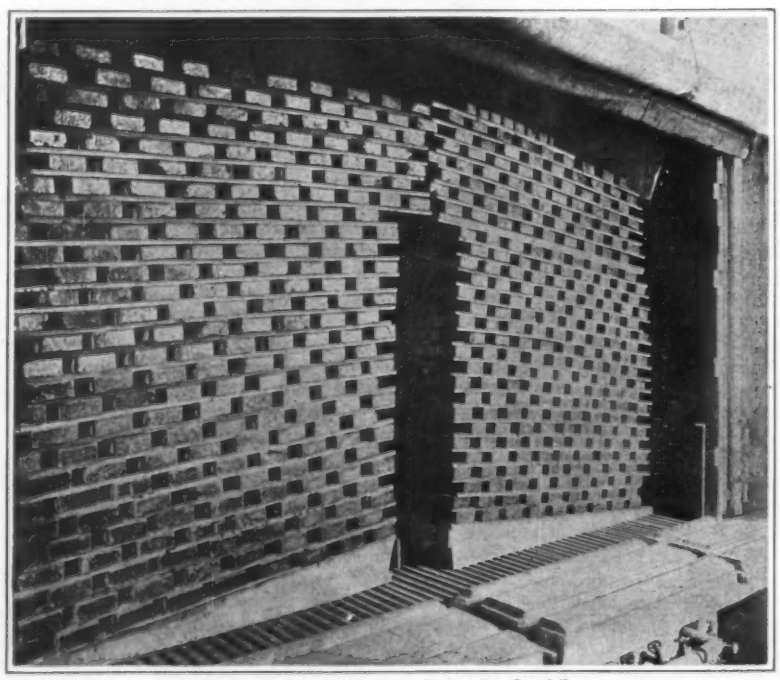
The old rule-of-thumb methods have had to give place to scientific methods and the successful operator has risen to the rank of an expert. Preliminary air-seasoning is no longer necessary or even desirable. Black walnut fresh from the tree can be thoroughly dried ready for the lathe in 60 days. Air-dried stock with from twenty-five to thirty per cent moisture content needs only 25 days in the kiln. In general, the time required for kiln-drying green hardwood lumber from one to three inches thick is 30 days per inch. For lumber less than one inch thick the rate is considerably faster, and for larger sizes than three inches, very much slower. In order to prevent end-checks due to the more rapid loss of water from the ends than from the surface the ends of the stocks are coated with a mixture of resin and tar which seals the pores and will not melt at the kiln temperatures. This end coating is applied at the mills which saw the lumber into blanks.



Copying lathe roughing out the butt of an Enfield rifle; the metal pattern is seen beside the stock



Gunstock in copying lathe with roughing-out process completed



Green blanks for gunstocks in the dry kiln

Even when dried under the best conditions there is likely to be some inequality in the distribution of the stresses in the wood which are likely to cause trouble when the stocks are made up. Tests are made on samples of the wood and if there are any unrelieved stresses in the material they are overcome by steaming and redrying. The steaming softens the fibers, makes them plastic, a sort of annealing process, and allows them to become adjusted to the reduced dimensions. The old prejudice against kiln-drying on the ground that the wood was weakened and made brittle or "had the life taken out of it," as the saying was, has had to give way to modern methods. The loss in drying gunstocks from the green condition to eight per cent moisture has been reduced to a fraction of one per cent. Where formerly years were necessary, now as many months only are required. The great amount of capital tied up in several years' supply of air-seasoning material has been released. And best of all an emergency call can be promptly met.

From the kilns the gunstock blanks go to the lathes where they are turned to shape. The forearm is slipped through the main mandrel and the butt held by the adjustable mandrel. As the stock turns the wood is chipped away by a cutterhead with a dozen curved knives on it, the shape being determined by a wheel following the smooth surface of a metal form or pattern, revolving in unison with the stock. The cutter moves along the stock until the butt part is completed, whereupon the stock is removed and placed into another machine which continues the process for the forearm. The rough-turned stock is inspected for defects and poor machining and if acceptable passes on through various machines which smooth it down, hollow it out and prepare it for the metal parts. In these processes a great deal of careful hand work is necessary as the stock must fit perfectly without binding anywhere. When birch is used the wood is stained so that the finished product bears a very close resemblance to the walnut.

Our readers will doubtless be reminded, by this copying lathe, of the machine for cutting airplane propellers which we illustrated and described some time ago. The two devices are of course only different applications of the identical idea—the idea of the pantograph, in fact.

Evolution of the Aircraft Engine

THE first man-carrying airplane flights were made in December, 1903, with the Wright Brothers' engine, developing 12 horse-power and weighing 152 pounds, or 12.7 pounds per horse-power. In 1910, or seven years later, the average horse-power of aeronautic engines had increased to 54 and the weight decreased to 5.7 pounds per horse-power. In another seven years, 1917, the average power output had advanced to 243 horse-power and the weight decreased to 2.8 pounds per horse-power. In March, 1918, the Liberty 12 developed 432 horse-power for a weight of 808 pounds, or 1.86 pounds per horse-power. At the present time the Liberty 12 is yielding a maximum of 450 horse-power for a weight of 825 pounds, or 1.83 pounds per horse-power.

The following table shows the advance in the average power-weight ratio by years for engines in actual flying use. It is to be especially noted that the Langley-Manley engine, built in 1901, was nine years ahead of its time in the matter of power output, and 16 years ahead in its weights per horse-power. In 1917 the Liberty 12 was 65 per cent more powerful and 28 per cent lighter per horse-power than the average in service for that year. So far this year these figures are probably changed to 50 per cent and 25 per cent, respectively, which indicate the advance of the Liberty over the average engine in service at the present time.

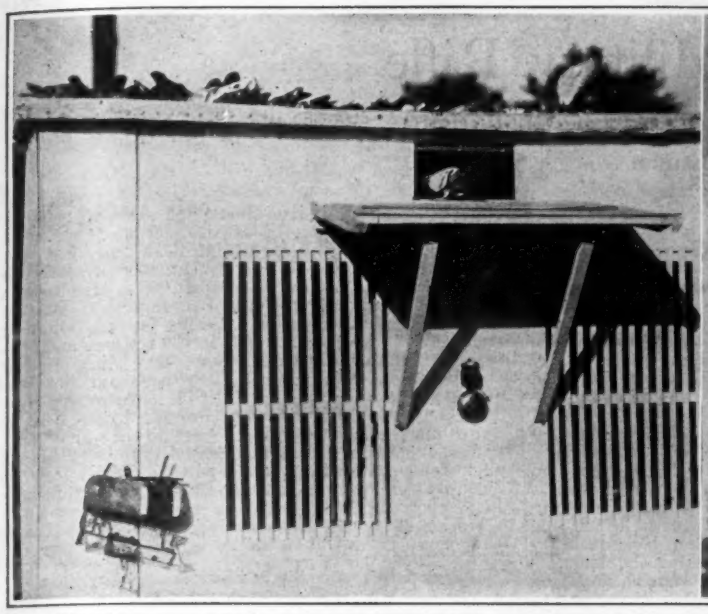
	Year	Horse-power	Weight	Weight per Horse-power
Langley-Manley	1901	52	151	2.9
Original Wright Bros.	1903	12	152	12.7
Improved Wright Bros.	1904	16	180	11.4
Improved Wright Bros.	1905	19	180	9.5
Redesigned Wright Bros.	1908	35	182	5.5
Average on Market	1910	54	309	5.7
Wolseley engine	1913	147	720	4.9
Average on Market	1914	112	437	3.9
Average on Market	1915	144	512	3.8
Average on Market	1916	185	570	3.1
Average on Market	1917	244	694	2.8
Liberty twelve	1917	400	801	2.0
Liberty twelve (March)	1918	432	808	1.9
Liberty twelve (May)	1918	450	825	1.8

The average consumption of fuel decreased from about 0.8 pounds per horse-power in 1903 to about 0.65 pounds in 1914, since which it has slowly dropped to 0.55 pounds in 1918, and for the Liberty to 0.50 pounds. The present Liberty consumption is approximately 0.46 pounds per horse-power hour.

Illustrating the advance made, the Wolseley Company in 1913 could only obtain 147 horse-power at 1,400 revolutions per minute from eight cylinders, five inches bore by seven inches stroke, or 18.375 horse-power per cylinder. This is the same sized cylinder as used in the Liberty, which now gives 450 horse-power at 1,800 revolutions per minute, from 12 cylinders, which is double the power per cylinder obtained in the Wolseley. Even if we reduce the Liberty results to the same speed as the Wolseley—that is, 1,400 revolutions—the Liberty still represents a great advance, for at that speed 350 horse-power are developed, or 29.2 horse-power per cylinder. Moreover, the Wolseley weighed 4.9 pounds per horse-power as compared with 2.3 pounds for the Liberty at the same speed, or 1,400 revolutions per minute.

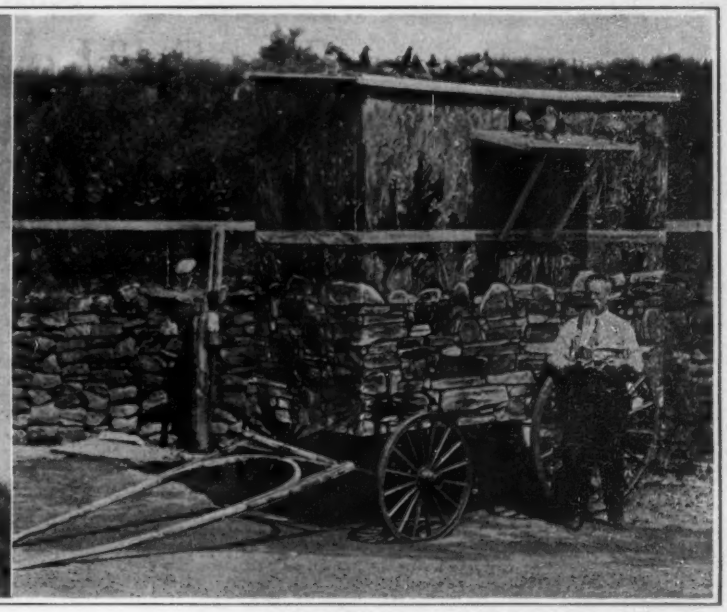
Sugar from Sorghum

IN a paper presented to the French Academy of Sciences, M. Guignard calls attention to the use of the sorghum plant as a source of sugar, especially on account of its abundant growth in the north of Africa and other places. His researches show that the amount of sugar may reach as high as 14 per cent. Although sorghum sugar does not crystalize as well as beet sugar and is inferior to it in quality, it will be useful to develop the production from this source now that other supplies are lacking.



The pigeon coop which announces the arrival of a messenger by the ringing of the electric bell

The pigeon parachute



The same coop as that shown at the left, in its coat of camouflage

The Pigeon Express

Safe and Efficient Handling of the Flying Messengers of the Battlefield

WE have had a good deal to say, and hope when occasion offers to say more, about the availability and the use of carrier pigeons in the war. The fact is that this bird, hitherto almost emblematic of peace, is employed for military purposes on a scale realized by few. Such a development has been made possible equally by special training of the birds, by special effort to secure an unfailing supply, and by special apparatus for use in connection with the pigeon service.

An interesting demonstration of the possibilities inherent in the last named direction may be seen at the headquarters of Mr. A. De Corte, in Rosebank, Staten Island. Mr. De Corte, a former resident of Belgium, has devoted much of his life to the raising of pigeons and dogs—his attention in the latter field having been concentrated upon a special variety of Belgian sheep dog known as the Groenendaele. When he came to this country he brought his pigeons and his dogs with him, and for some time he has been engaged in working out a system for improved utilization of the former in the trenches. In designing special equipment for this purpose he has displayed much ingenuity.

Mr. De Corte has proceeded on the theory that communication by pigeon is essentially an emergency measure. Obviously it will only be resorted to when wires are absent or have failed, and when the small numbers of the force which wishes to send a message, or its isolated and exposed position, make inadvisable the attempt to despatch a runner. In a word, the rôle in which the pigeon stars is in taking a message to headquarters from a body of troops who are cut off from their fellows in advanced trenches, in shell-holes among the enemy, or as the result of unadvised penetration into hostile territory, or an unexpected enemy advance. Accordingly the first thing to ask is how such a party is going to get pigeons.

Frequently the possibility of being cut off is evident in advance, as when a patrol is sent out to examine the enemy position; and Mr. De Corte would then have the detachment carry its pigeons with it. For this purpose he has fashioned the wire cage which we illustrate in several places on this page. As is plain from the picture showing the cage in the hands of its inventor, this affair is just large enough to hold one bird firmly but comfortably. For convenience of transportation it is suspended upon a stout leather thong provided with a long slit by means of which it can be secured to a button. We attached it thus to our vest button, and were willing to concede that alike in weight and in bulk, the cage with the bird in it, when so disposed of, would offer no appreciable impediment to marching or, within moderation, even to fighting; and for convenience in packing and in handling, this scheme of pigeon transportation would be hard to beat.

Mr. De Corte and his improved carrier-pigeon cage

The leather cover of the cage is buttoned down by two thongs similar to the one from which the device is hung. On the inside of the cover, so arranged that their contents can be got out without lifting the lid, are compartments for paper and pencil. When closed, the firm leather top offers an excellent table for the writing of the message.

Especially novel and interesting is the means employed for attaching the message to the bird. Each pigeon wears a permanent harness of leather, which passes over the neck, under the wings and around the legs. This is never removed. It hugs the bird's body closely, and after it has been on for a few hours, it buries itself in the feathers, which conceal it completely from view. Firmly attached to the harness is a little tube of hard leather for the reception of the message. This hangs beneath the bird's body and between his feet; and so effectively is the harness hidden that we were obliged to take up one of the birds and handle him freely before we were able to discover how the tube was attached to him.

As the bird is held in the hand, or as he struts about, the tube is visible. When he flies, however, it is almost as impossible of detection as the harness itself; for the position of tail and wings is such as to afford it effective camouflage. It is, therefore, out of the question for the hostile force which sees such a pigeon to decide whether it is their own or an enemy bird, or, in fact, whether it is a carrier at all. The leather tube for the message, we may remark here, is sufficiently elastic to grip the paper firmly; once rolled up and inserted in its place, the message can be removed only after a distinct, sustained, and well directed effort. We are inclined to accept the designer's claim that accidental loss of the message is a contingency too remote to dwell upon, and that this whole process of attachment is a great improvement over more conventional procedure.

The inventor has not stopped here, after providing a means for carrying the pigeons along against an anticipated emergency. He has reasoned, in addition, that a force will often be cut off unexpectedly, and while thus isolated, will wish to send back information concerning their own condition or the enemy's movements. When this happens, some friendly aviator will doubtless discover the fact. But it will not be possible for him to render effective relief, because he will not know what is needed; and if it is a matter of sending back information, it is not always the case that a detachment unexpectedly cut off has been able to assure itself that it will have the proper instruments for signalling to a passing plane. Here is where the pigeon comes in again.

Perhaps a dog can reach the position in safety where a man cannot. If so, we have the dogs and the means of attaching pigeon cages to them. The Groenendaele is of medium size, amiable, obedient, alert and practically tireless. As will be seen from the photograph, he is much akin to the Belgian and French army dogs which have been so freely pictured of late. Specially trained for such service, the pigeon cage can be strapped to one of these animals, and off he goes. Or perhaps even this is out of the question; there still remains a resource. A friendly airplane, flying low, can drop a pigeon in its cage, on a light parachute. If the attempt to get the range of the defending party with this outfit fails once, it can be repeated. And once it succeeds, the pigeon may be despatched to headquarters with a message of very considerable length. We ourselves folded an ordinary commercial letterhead into quarters and then rolled it up tightly enough to go into the tube. Upon such a sheet a competent observer could write enough information to strafe a goodly section of the Hindenburg Line.

In the means for insuring the safe receipt of the message equal ingenuity has been shown. The bird, upon returning, enters his home coop through the only door by which it is possible for him to enter. But this door is a trap; once in, he cannot go back out again, while the compartment in which he finds himself is a prison, from which he cannot escape to his living quarters until someone comes to release him. Finally, the floor to which he is thus admitted is supported by a delicate spring; and under his weight it is depressed far enough to make an electric contact, ringing the bell which is seen on the front of the house. As long as the bird remains unreleased, this bell will ring whenever he touches the floor of his little jail; and as he has not space enough to flutter about much, he must ring pretty often and pretty continually, thus giving notice, to the man whose business it is to come and get the message, that a message has arrived. It may be remarked that if several birds arrive at about the same time, the presence of the first one in the entrance hall will not prevent the others from entering. The trap door will admit as many pigeons as can crowd into the space provided; its only restriction is that none of them can leave by it.

Mr. De Corte's pigeon cage, pigeon coop, pigeon parachute, and pigeon balloon (the latter is not illustrated), have all been patented for use in time of war. The advantages which he claims for his system of using the feathered messengers are simple and quick operation, protection of the birds from improper handling, and the possibility of writing longer messages. In addition, the message may be placed on the pigeon, through the opening in the floor of the cage, without opening the case and risking premature escape of the bird. Finally, the message may be placed in the tube and the bird released with one hand, without touching the pigeon and thus without impairing his flying qualities.

Electric Cast Iron

A DEVELOPMENT of war conditions in the steel industry of the United States has been the demonstration of the possibility of making pig iron and iron castings direct from steel scrap in an electric furnace—something never accomplished before. It has been claimed that such iron, cast in the form of castings, is far superior to the same castings made from ordinary pig iron, melted and cast. Tests of this new iron recently made at Columbia University demonstrate its high quality. Its tensile strength was shown to be 40,730 to 45,030 pounds per square inch, considerably higher than of ordinary cast iron.

A Belgian sheep dog ready to deliver a pigeon to an advanced party

The Self-Loading Military Rifle

The Gun That Operates Its Own Breech Mechanism

By Edward C. Crossman

DURING his continuous performance of the past four years, old grim-visaged Mars has demonstrated at once the great desirability of a self-loading infantry rifle, and the great difficulty of filling an order for a satisfactory one.

Unfortunate was the emergency that compelled this country hastily to recommence the manufacture of our New Springfield, and to adopt as supplement therefor, a modified version of the British Enfield Model 1914, which is merely the Springfield in the principal points thereof. The fighting during the great war had shown the urgent necessity for an infantry rifle that would give as near as possible to machine gun speed of fire. Small arms firing regulations of both our own and the British armies have been modified to lay stress on the importance of rapid fire, real rapid fire, not the rather leisurely procedure that has masqueraded as rapid fire in our firing courses—for instance, ten shots in one and a half minutes.

British army friends write me that the best remedy for the attempt of Fritz to come over and visit with them in their own fire trench is 15 rounds rapid, which means 15 rounds in one minute. This rate utilizes to about its full capacity, the rapid fire possibility of the hand-operated rifle, although skilled men have fired 25 and 30 aimed shots per minute in special test.

The change in army procedure shows plainly the necessity for a high rate of fire with accuracy, and this in turn indicates plainly the self-loading rifle as the rifle par excellence. Such a weapon permits of a much higher fire rate, does not disturb the aim in bolt manipulation, does not expose the manipulating hand and arm and puts all men on the same basis of rapidity if not accuracy in that the painfully acquired technique of working the bolt rapidly is not at all necessary.

In days gone by, when fighting was at greater range and the infantry didn't burrow into the ground at the slightest pretext for a halt, the difficulty of fire control lay in making the men fire slowly enough. At all but the close ranges of the so-called "normal attack," the rate of fire was two shots per minute. A rate higher than this was held incompatible with accuracy and coolness of fire and ammunition conservation. Now the faster the soldier can fire and still remain accurate, the better, merely because the ranges are usually short, the speed of the attackers great, and the time in which to break up the charge uncomfortably short.

Light machine guns, re-baptized automatic rifles to differentiate them from the heavier type machine guns, are carried by a given number of men in each company, forming a machine gun platoon. To give every infantryman an automatic rifle of this sort would make the fire still more effective, but obviously, because of the question of ammunition supply and of the weight of the arm itself, this is out of the question.

How the Self-Loader Differs From the Machine Gun

The next best thing is the rifle that does all the work of breech manipulation by virtue of the energy of recoil or by gases taken from the barrel, leaving to the soldier firing it only the work of pulling the trigger for each shot. The speed of fire of such rifles—sold in sporting form over the counter of all sporting goods stores—is limited to the rapidity with which the firer can twitch his trigger finger, up to the limit of the capacity of the magazine. They differ in principle from the true machine gun only in that the trigger must be pulled for each shot, and of course in the absence of the cooling and magazine features of the machine gun or automatic rifle.

Every civilized nation has experimented with military rifles of this type. No rifle came up to the scratch in pre-war days in all the points of simplicity, endurance and reliability. Now the demands on the rifle in the way of ease of cleaning and care and immunity to abuse and mud and grit are greater than in the days before the war. The need for the self-loading rifle is shown more plainly than ever—and the satisfactory rifle to fill the need seems farther away than ever.

Rifles that do the work of breech manipulation are divided roughly into two classes—the recoil operated and the gas operated. Machine guns follow the same classification, and are about evenly divided in actual number now in operation. The Maxim, the standard German machine gun, is recoil operated. The Benet-Mercier, the Lewis and the Colt are gas operated.

Recoil Operated Rifle

The sporting rifles sold to hunters are confined strictly to the recoil operated type, the list taking in the Remington, the Winchester and the little known Sjogren of England. The designer of the recoil-operated, self-loading—often miscalled automatic—rifle is confronted with the difficult task of both locking his rifle firmly against the thrust of the cartridge in the chamber, and yet utilizing that push to operate the mechanism of the rifle. If it is permitted merely to oppose a heavy unlocked bolt and a powerful spring to the backward push of the cartridge, then the task is easy, and we get what is called the "blow-back" type of weapon, a type including the familiar and successful Winchester self-loading rifles and various automatic pistols. In this type there exists a necessarily delicate balance between backward thrust of the cartridge case in the chamber, and the weight of the bolt and push of the main spring or retractor spring behind it. If the bolt and spring offer inadequate resistance then the speed of recoiling parts will be too great and there will be an escape of powder gas at the breech, not to mention the probability of blowing the cartridge case in half because the back portion would try to back out under gas pressure, while the forward and thinner one remained glued to the chamber walls by the same lateral powder pressure.

If the bolt and spring offer too much resistance, then the rifle will merely not function. Any overload or any serious obstruction in the bore, tending to raise the chamber pressure, would destroy this balance and so the refusal of military boards to countenance this type of action. However, it works nicely in arms of the sporting sort.

While necessitating a clumsy barrel cover, the Browning plan of recoil-operated rifle is thus far the most practical and one much copied by "designers" of foreign rifles of the military automatic type.

In the Browning plan, used in the Remington big-game series of self-loaders, the recoil of the fired cartridge drives backward the breech bolt and the barrel, firmly locked together, the barrel sliding in guides provided therefor. The backward motion compresses the retractor and main springs. At the end of the travel, which is about the length of a cartridge, a trip releases the lock between bolt and barrel, the heavy retractor spring drives the barrel forward to position again, ejecting the fired case, while the breech bolt is momentarily held back. A fresh cartridge rises into the path of the bolt, which then flies forward, carrying the new cartridge into the chamber, and locks itself by the turning of the bolt head into locking shoulders, as with the Mauser hand operated rifle. Here the delaying action of barrel and bolt sliding together serve both to prevent the undesirable unlocking of breech bolt while powder pressure is in the chamber, and to compress the requisite springs to carry out the reloading and closing sequence of actions.

In the Sjogren there is a heavy unlocking bolt on the breech bolt proper, arranged to slide freely in a line with the bore. On discharge the sliding bolt remains stationary, the rifle sliding beneath it until, at the end of the travel, the bolt unlocks the breech bolt proper which then opens under the reduced powder pressure and operates like the bolt of a straight blow-back rifle—sliding backward, ejecting the fired case, cocking the striker, compressing the retractor spring, and finally closing again on a fresh cartridge fed up from the magazine. Here the sliding unlocking bolt serves merely to delay the unlocking of the breech bolt until the powder pressure is off the head thereof.

The Browning plan is used on the Danish Schoeboe rifle submitted in military form to our War Department in 1909. The same scheme is used in the case of the Swedish Kjellman rifle submitted in 1910.

The Forward-Moving Barrel

A third application of the recoil operated principle is the forward-moving barrel idea, seen in the Swartzlose automatic pistol, sold in this country prior to the war. Here the "drag" of the bullet against the light barrel is alleged to force the barrel forward to the limit of its travel, compressing the retractor spring and cocking the arm, whereupon the barrel backs into place on a fresh cartridge that rises in front of the bolt and the arm is closed for firing. As a matter of fact the pistol in part backs away from the barrel much as the Sjogren rifle backs away from the sliding locking bolt. This is proved by the fact that if the firing hand is placed against a wall and the trigger is pulled, the gun will not function; the backward jump of the pistol has really more to do with the functioning of the gun than the actual forward motion of the barrel.

A highly successful automatic military rifle, invented by Sir Charles Ross, of Canadian Ross fame, and operating on the forward moving barrel principle, has been submitted in various forms to the Ordnance Department, and evidently contained much that had merit inasmuch as the arm has been altered to conform more to their demands. While there is not the slightest disposition on the part of the barrel of a gun to move forward when a cartridge is fired in its chamber, there is much willingness on the part of the rest of the rifle to recoil back away from the barrel if the latter is not firmly connected to the arm, and so it is entirely possible to make a rifle function by having the barrel stand still in its guides and let the rest of the arm recoil away from it. The effect is that the barrel slides forward—as would be the operation were the gun loaded by hand.

Gas Operated Rifles

All devices depending on recoil, however, are more or less clumsy and complicated compared to the simple plan of taking a little gas from the barrel and using it to operate a gas-engine type of miniature piston in its cylinder below the barrel. This is the operating principle of the Benet-Mercier and Lewis guns. The Colt uses gas, but lets it impinge on a lever hinged below the barrel and working downward through a portion of a circle on its hinge.

Some years ago, a self-loading sporting rifle of this type was put on the American market, but owing to various political difficulties in the factory itself rather than to any fault of the principle, this rifle is no longer made. Here the gas was taken out of a very small "port" bored in the lower portion of the barrel 20 inches or more from the breech. On the passing of the bullet, the gas following at high pressure passed down through the little pin-sized port into a cylinder lying below the barrel, and there it impinged upon the head of a piston and drove it backward until the piston passed relief ports cut in the cylinder and the gas could escape into the air. The backward motion of the piston was of course translated into the various motions necessary to unlock the breech bolt, drive it to the rear, cock the striker, etc. A valve at the port below the barrel regulated the amount of gas passed into the cylinder, avoiding excessive slam of working parts by high gas pressure, and yet permitting a trifle greater gas escape in case cold parts or grit required more force to operate the rifle.

This principle is purely the utilization of a miniature gas engine, deriving its charge from the gas behind the bullet. The small portion "borrowed" had no effect on the ballistics of the arm. Such gas operation permits the use of the simple and strong bolt of military type.

It is absolutely safe in that the operation of the rifle cannot commence until the bullet passes the port well up the barrel and that means that its exit into the air is then a matter of time almost too short to measure.

General Mondragon of Mexico designed a rifle on precisely this principle for the Mexican army just prior to the Madero revolution, and a number of such rifles were made. He used the backward drive of the piston to revolve a military type of bolt through an eighth turn as a soldier would do by hand, freeing the lugs from their engagement with the shoulders in the receiver and driving the bolt to the rear. This gas-borrowing principle is also used on the experimental British Laird Mentyene Degaille rifle, the Farquhar-Hill rifle of converted Lee-Enfield type and on various experimental rifles built by our own arsenals for experiment prior to the war.

The objection to the gas operated type of rifle is the slight tendency for the working parts to corrode from the gas used to move them, and the slightly greater difficulty in keeping the bore clean, due to the creeping up of corrosion from the unreachable gas-port in the barrel. Care can prevent this trouble.

Requirements of the Self-Loading Military Rifle

The successful self-loading military rifle should operate in three distinct ways. The first, the ordinary hand operation of bolt, to be used for slow fire at long ranges to prevent waste of ammunition. The second, the semi-automatic functioning in which the breech bolt opens under gas pressure but is closed by hand by the soldier or else allowed by the soldier to close under spring pressure at the touch of a catch. This also slows down the fire rate and aids control. The last is of course the straight "automatic" function of the rifle for rapid fire, in machine-gun fashion save that the trigger must be pulled for each shot.

Any such rifle could be easily converted to straight machine gun automatic fire by installing a cam bolt to turn down the sear out of the path of the firing pin and let it return against the primer each shot; but with the light weight of the rifle the rapid sequence of shots would "bounce" it all over the place and the limited magazine capacity would make this sort of fire—400 to 600 shots per minute—entirely useless in that it would empty itself in a second or so. Many an incautious experimenter with self-loading sporting rifles has got the trigger mechanism out of order, and had the rifle remark, "Pra-a-a-a-p," with the entire magazine the first time he pulled the trigger. It is an experience more surprising than pleasing.

The ideal rifle of this self-loading type would permit the simple manipulation of the bolt by the soldier for slow fire without compressing each time the powerful retractor spring, which is somewhat of an effort and which would make the manipulation of the rifle even slower than was desired.

Practically any rifle of this type can be fired at an astonishing rate of speed. Five shots can be fired in two seconds without trouble, a 20-shot magazine can be emptied in as many seconds with fair accuracy. Wherefore the self-loading military rifle, to permit the utilization of its rate of fire, must have ample magazine capacity—not less than 15 rounds, preferably 20 or 25, clumsy as it might make the arm.

At a reasonable estimate the fire of a given number of men with such weapons and large magazine capacity would be equal to the fire of three to four times their number armed with the present type of hand-operated rifle, if the occasion was stopping a rush by a close-at-hand enemy.

But the speed of fire and consistent working are, alas, not all that are necessary for the successful rifle. It must be capable of being quickly taken apart for cleaning and the reduction of jams, must have few parts and those strong, must be immune to grit, water and mud—must in short be nearly as simple and easy to care for as the present universal Mauser type. Because such a rifle had not arrived by 1914 the British adopted their 1914 Enfield. Because it had not arrived by 1914 every nation in the war is still using the manifestly inadequate and slow and out of date Mauser type of bolt rifle to check rushes where the utmost speed of fire is called for.

The American Cutlery Industry

MANUFACTURERS of cutlery in the United States total about 100, which is less than half the number similarly engaged in Sheffield, England, alone. These figures, however, afford no clue to the comparative output of the two countries because the multitude of very small makers in Sheffield has no counterpart in the United States. The conditions differ also in that very few American manufacturers attempt to supply all descriptions of cutlery. Specialization is the rule with them, whereas in England it is the exception.

Only about twenty American firms make ordinary razors, and most of these supply no other kinds of cutlery. The manufacture of safety razors is a distinct branch of the trade occupying 26 makers of whom only three or four make anything else. The manufacture of scissors and shears engages more than thirty firms.

Before the war the United States imported a large quantity of cutlery, especially razors and cutlery parts from Germany, and butchers', pocket and "article" knives from Sheffield. The American export trade in general cutlery was negligible, but American safety razors and shears had a good sale in Britain, Canada, and Australia. At that time the use of stainless knives was making rapid headway in the United States, Sheffield supplying very large quantities, but this business was closed down nearly a year ago when the British Government prohibited the use of chrome steel in the making of cutlery.

It is claimed that the United States now leads the world in quality as well as in quantity of cutlery, and that with German and Austrian cutlery eliminated by the world war, possibly never to return, and with productive facilities and skilled labor in England at a low ebb, the United States has stepped into a leading position.

Cooking Corn Cobs

The Promised Utilization of One of Our Greatest Waste Products

WE are living at a moment when the greatest interest attaches to the conservation of resources and the utilization of waste materials. We are making every effort to insure that the systematic discarding of potential values so characteristic of nineteenth century industry shall cease. And one of the greatest potential values for which we have not heretofore found a use is the much despised corn cob.

The United States is the world's greatest producer of this cereal. Our annual corn crops range from two and one-half to three billion bushels. Expressed in bulk, this is about equal to our crops of all other cereals combined, and represents at least seventy per cent of the world's production.

For every bushel of corn, there is approximately one bushel of cobs which, however, weigh only about one-third as much as the grain. These cobs are not now utilized to any extent. They have a certain value as fuel, and they have been used as an ingredient of stock feeds. They contain, however, little or nothing that is directly available for animal nutrition. Since, therefore, they represent an almost total waste, corn cobs constitute, in view of the enormous amounts in which they are produced, perhaps our greatest agricultural waste product. But from the chemical standpoint, they represent a very valuable source of material from which many useful products could be successfully obtained on a commercial scale, if we but knew how to go about it.

Work recently done by F. B. La Forge, of the United States Bureau of Chemistry, seems to point the way to a complete solution of this problem. It is of interest first to note that, as so often happens, Mr. La Forge was precipitated quite by accident into the study of the field in which he appears to have done such good work. He was engaged in another investigation altogether—one in which he required considerable quantities of the wood-sugar, xylose. In accordance with accepted methods, he prepared this by treating corn cobs with sulfuric acid. While engaged in his work with the xylose thus obtained, the idea presented itself to him of deriving from it the acid base of baking powder; and as this would involve its utilization on a large scale, his interest was of course aroused to the possibilities of producing it commercially upon such a scale. But since the manufacture of xylose calls for only a small part of the cob, the most casual attack upon this problem could not fail to draw attention to the more inclusive one of finding a commercial application for the whole cob. The results of Mr. La Forge's investigations into this very significant by-way of industrial chemistry, while as yet unpublished, have already formed the subject of a talk given by him before the New York Section of the American Chemical Society; and it is from this talk that the following account is abstracted.

There are four principal products which may be derived from the corn cob. First comes a colloidal material consisting chiefly of a modified form of xylose, and which is obtainable to about thirty per cent of the original weight of the cobs. It is immediately available as an adhesive in the paper box industry, in bill-posting, labelling, etc., where its use in place of starch, dextrine and flour paste would make possible an enormous saving of these foodstuffs. After this substance has been removed from the cob, the next items obtained are about five per cent in weight, of true xylose, and an indeterminate amount of acetic acid. Finally, the balance of the cob is at this point reduced to a very finely divided cellulose, which for many purposes might be expected to replace cellulose from other sources. Its physical state is such that it is capable of taking up unusually large amounts of liquids, syrups, etc.; so it could certainly be employed as an absorbent for the molasses in stock food, while many other uses would doubtless develop. The discoverer suggests that it might be available as a base for dynamite manufacture.

While the methods for obtaining these four principal products from corn cobs have not yet been tested out on a large factory scale, they are at least out of the laboratory stage, since the work is now carried on by means of autoclaves, powerful presses, centrifuges, and other equipment of corresponding magnitude.

The first stage of the process is the preparation of the adhesive material. For this, the cobs are placed in a copper-lined autoclave, with just enough water to cover them, and are then subjected to heating at suitable temperature for about an hour. After cooling, the autoclave is opened and the contents subjected to strong pressure to expel the liquid from the undissolved solid residue. This liquid is then evaporated to a syrup in the open, and the product is ready for use at once. The whole process reads so very like an ordinary job of cooking that it must help impress upon us that, after all, cooking is just a question of chemistry—or, perhaps better, that chemistry is, after all, nothing but cooking with a college education.

For the recovery of the xylose which is responsible for the whole development, the solid residue from the first step is heated again in the autoclave, just as before, except that in this case about two per cent of sulfuric acid is added to the water used. The result of this cooking is an acid solution containing the desired xylose; and this is evaporated, in a vacuum, to a thick syrup which, upon being left to stand, deposits the xylose in good crystalline condition. Here again, it will be observed, we have perfectly good cooking terms and procedures. But the good old fashioned cook who separated her precipitates by skimming or draining or straining is left completely in the lurch by the up-to-date chemical cook. The latter, after a suitable length of time, whirls the acid mother liquor about in a centrifuge a few times, and separates the crystalline xylose in this more effective fashion.

It will be seen that, in this process for obtaining xylose sugar from the corn cob, we have just about the same procedure as that employed in recovering the crystalline substance from the juice of cane sugar. In fact, the immediate product is almost pure white and greatly resembles cane sugar in appearance. It is, however, only about half as sweet. As suggested, its chief use is not as a sugar, but rather as a starting point in the preparation of gulonic lactone for use as a baking powder acid. The procedure here has been fully developed, along two lines, either of which appears to be quite feasible commercially.

An alternative use for the large amounts of xylose which would become available if the manufacture of corn-cob products should be undertaken on a large scale would be its conversion into xylotol by reduction. This substance, a polyvalent alcohol, has almost the same physical and chemical properties as the more familiar glycerol and could serve in many cases as a substitute for the latter. Work on the commercial reduction of xylose to xylotol is about to be undertaken.

In the operation last outlined, acetic acid is obtained with the xylose. The centrifugal separation does not distinguish between it and the balance of the liquid; but it can be recovered by allowing the steam from the autoclave to escape through a condenser.

We come now to the fourth product, and the final one so far as the mere reduction of the cobs is concerned. This is the crude cellulose which remains after the extraction of the xylose and the acetic acid. This material represents about fifty per cent of the weight of the cobs, and is simply a highly porous and disintegrated form of cellulose. It contains a brown material which may for most purposes be disregarded, but which, when necessary, may be removed by leaching with dilute alkali solution, since it is alkali-soluble. This treatment yields a material which is almost wholly white. The possibility of uses based on the ground of its absorptivity has already been suggested; and these of course are direct, without further preparation. Its principal use, however, would be in the further manufacture of glucose. The method advocated for this is not at all new, being but an application of the very old process of Bechamp.

The press cake from which the xylose has been removed is washed, dried and ground. The resulting flour is mixed with enough 75 per cent sulfuric acid to form a stiff dough. The only feature of this that would be at all strange to the farmer's wife would be the use of a deadly poison to wet the dough. This dough is allowed to stand for some hours—obviously to undergo the changes which are paralleled in the rising of the more familiar kind of dough. Then it is mixed with water and boiled for about an hour, after which the undissolved solid material is filtered off with a filter press, and the sulfuric acid removed by an application of slacked lime, followed by another filtering to get out the resulting calcium sulfate. The neutral solution remaining from all this is evaporated, yielding a light brown syrup which crystallizes to a solid cake in short order. As a matter of fact, however, we err in calling this solution neutral; it should be so, but it isn't. There are traces of acid present, as well as a good deal of the calcium sulfate that escaped the filter. By treating it with decolorizing carbon before evaporation this state of impurity is partly remedied; while the amount of sulfate present is reduced to a minimum by filtering it just before it reaches the syrupy state—at the

(*Continued on page 283*)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Not a New Arm

To the Editor of the SCIENTIFIC AMERICAN:

I note with considerable surprise the article on "A German Substitute for Browning Rifle" with copyrighted photograph on page 215 of your issue for Sept. 14th. You are misinformed as to this being a new arm. I have one of them before me, identical with the one illustrated, complete with its stock-holster. I purchased this some ten or more years ago from a Broadway sporting goods house, whose name, together with that of the maker, "Waffenfabrik Mauser, Oberndorf am Neckar," is stamped on the frame. The box magazine takes ten 7.65 mm. cartridges; I was advised that another model was made taking 20 cartridges.

I have become so accustomed to regarding my SCIENTIFIC AMERICAN as infallible that I venture to make the above correction; as, I dare say, dozens of others have done by this time.

Lakewood, N. Y. J. W. PACKARD.

Cultivating Battle Fields

To the Editor of the SCIENTIFIC AMERICAN:

A consignment of SCIENTIFIC AMERICANS reached me in the last mail. I have been deeply interested in all of them, but gave considerable consideration to an article, "Can Shell-Scarred Battlefields be Cultivated?" appearing in the February 9th issue of this year. The question came to my attention very early in the spring and since then I have studied it to the best of my ability.

Upon entering a sector, troops examine the shell holes and craters to determine how recently or how extensively an area has been shelled. This is done by a consideration of the erosion which has occurred and the amount of vegetation growing therein. Considerable accuracy is attained in this manner in determining the activity of a front. I have never seen a shell hole considerably eroded without at least a few blades of grass and perhaps a poppy. I have inspected regions that have been "gassed" by all of the more common asphyxiating fumes used by the Germans. There is positively no indication of a permanent "poisoning" of the ground thus treated. At one time this last year I had the leisure to examine soil under cultivation that had been considerably shelled early in the war. My attention was attracted by numerous circular plots more verdant than the average of the land. These plots were incircled by a ring of still more verdant grass. Thorough inspection showed that each one of these plots was a former shell hole which had been diligently filled and leveled by the laboring husbandman. Not that I approve of the practice, but land that has been torn and ripped by high explosives and shrapnel has been decidedly improved thereby.

The method of reclaiming around which No Man's Land has swung back and forth across has been discussed. The most practical method on a large scale would be to utilize the great "tanks" that will be thrown out of employment by the cessation of hositilites. But I do not believe this method will be much used. I have been on detached service as Chief Gardener in a village within the Zone of Trenches. In the absence of the civil populace, it was my duty to utilize the numerous gardens for benefit of the occupying troops. The gardens were pitted with shell holes and crossed by entanglements. Leveling the shell holes with short handled heavy French hoes was but a slight matter. No attempt was made to remove the wire entanglements because of their future possibilities. But, farther behind the lines, French peasants could be seen removing the stakes and wire, bit by bit. In this manner the land will be reclaimed. The trenches, artillery pits and dugouts are rapidly eroded by nature. In sections from which the Germans have been driven the patient husbandman has laboriously cleared the soil and planted it, with the hopes of refugees returning to the homes of their childhood.

During these days of strife and turmoil we may look forward to the Peace that must come, with calm confidence that Nature will be more bountiful in this blood scarred land than in all the rest of the world.

Co. E. 166 Inf. American E. F. ERNEST LOTZPOT.

"Toothless Saws in the Sixties!"

To the Editor of the SCIENTIFIC AMERICAN:

In the SCIENTIFIC AMERICAN of August 24th, 1918, appeared a letter from C. H. Roth, in which the origin of the toothless saw for cutting metal was placed as early as 1884. I am afraid it will have to be pushed even further back than that.

In December, 1861, I enlisted in the "Curry Dragoons" a cavalry company, which was then quartered in cotton compress-warehouses in Mobile, Ala. There were building here, near our quarters, two wooden gunboats for the Confederate navy, and my company mates, including myself, frequently visited the yards, where the work of building these gunboats was to be seen.

To my surprise I saw in one of these yards a circular disk of steel, without any teeth, but perfectly smooth, being run at high speed, and used to cut in two, bars of iron for the gunboat.

On April 2d, 1865, General Wilson's Cavalry Corps captured and burned the city of Selma. Among the buildings burned was the C. S. Naval Foundry, in which were a large number of heavy guns, in all stages of completion. The ground on which the Naval Foundry stood, and all the guns, machines, and unburned materials and tools of every kind, were condemned by the U. S. Court, and sold under its decrees.

At the marshal's sale, all the heavy guns were bought by a man and shipped away, but to handle these large guns was too difficult, so he rigged up a steel disk, driven by a steam engine, at a very high speed; and with this smooth disk he sawed up the guns into many pieces, so that they could easily be rolled along by one man; and in this way he shipped off all the iron of the former naval foundry. I saw this smooth saw in operation several times, and it cut through a large gun, apparently as easily as though it had been wood.

Until some one can show that the "toothless steel saws" were used *before* the Confederate mechanics used them, as I saw in 1861 and again in 1866, I shall claim for them the credit of having invented the "toothless saw."

Selma, Ala. SAM'L WILL JOHN.

The Essen Coal Fields

To the Editor of THE SCIENTIFIC AMERICAN:

Once upon a time, so legend runs, two Germans, strangers to each other, sat at the same table in a café. One of them had a very red nose. After awhile the other queried: "Why is your nose unlike a Krupp cannon?" Mr. Red Nose was nonplussed! "Because," his table companion continued "your nose comes from *trinken* and a Krupp cannon comes from *Essen!*"

Now there is a lesson in this at the present moment when peace is looming up under the guidance of great Ferdinand Foch. For why do Krupp cannon come from Essen? And the answer is simple: Krupp cannon come from Essen because Essen is in the center of the great coal field of Germany. It is, however, a remarkable fact that in the many suggestions about what should be done when the German people finally cry "*Kamarad!*" one hardly ever finds, except in one small book by Dr. C. W. Macfarlane, a reference to the Essen coal field.

And yet the Essen coal field is perhaps the most important asset toward keeping peace in future. Take it away from Germany together with the Lorraine iron mines and there will be no more Krupp cannon. And for my part I pray that when the Allies dictate the peace terms at Berlin, they will hand over the Essen coal field to Belgium. That would indemnify to some extent poor Belgium. And it would also for all time draw the fangs and extract the claws of the Hohenzollern monster.

Philadelphia, Pa. EDWIN SWIFT BALCH.

The Self-Loading Military Rifle

The Gun That Operates Its Own Breech Mechanism

By Edward C. Crossman

DURING his continuous performance of the past four years, old grim-visaged Mars has demonstrated at once the great desirability of a self-loading infantry rifle, and the great difficulty of filling an order for a satisfactory one.

Unfortunate was the emergency that compelled this country hastily to recommence the manufacture of our New Springfield, and to adopt as supplement therefor, a modified version of the British Enfield Model 1914, which is merely the Springfield in the principal points thereof. The fighting during the great war had shown the urgent necessity for an infantry rifle that would give as near as possible to machine gun speed of fire. Small arms firing regulations of both our own and the British armies have been modified to lay stress on the importance of rapid fire, real rapid fire, not the rather leisurely procedure that has masqueraded as rapid fire in our firing courses—for instance, ten shots in one and a half minutes.

British army friends write me that the best remedy for the attempt of Fritz to come over and visit with them in their own fire trench is 15 rounds rapid, which means 15 rounds in one minute. This rate utilizes to about its full capacity, the rapid fire possibility of the hand-operated rifle, although skilled men have fired 25 and 30 aimed shots per minute in special test.

The change in army procedure shows plainly the necessity for a high rate of fire with accuracy, and this in turn indicates plainly the self-loading rifle as the rifle par excellence. Such a weapon permits of a much higher fire rate, does not disturb the aim in bolt manipulation, does not expose the manipulating hand and arm and puts all men on the same basis of rapidity if not accuracy in that the painfully acquired technique of working the bolt rapidly is not at all necessary.

In days gone by, when fighting was at greater range and the infantry didn't burrow into the ground at the slightest pretext for a halt, the difficulty of fire control lay in making the men fire slowly enough. At all but the close ranges of the so-called "normal attack," the rate of fire was two shots per minute. A rate higher than this was held incompatible with accuracy and coolness of fire and ammunition conservation. Now the faster the soldier can fire and still remain accurate, the better, merely because the ranges are usually short, the speed of the attackers great, and the time in which to break up the charge uncomfortably short.

Light machine guns, re-baptized automatic rifles to differentiate them from the heavier type machine guns, are carried by a given number of men in each company, forming a machine gun platoon. To give every infantryman an automatic rifle of this sort would make the fire still more effective, but obviously, because of the question of ammunition supply and of the weight of the arm itself, this is out of the question.

How the Self-Loader Differs From the Machine Gun

The next best thing is the rifle that does all the work of breech manipulation by virtue of the energy of recoil or by gases taken from the barrel, leaving to the soldier firing it only the work of pulling the trigger for each shot. The speed of fire of such rifles—sold in sporting form over the counter of all sporting goods stores—is limited to the rapidity with which the firer can twitch his trigger finger, up to the limit of the capacity of the magazine. They differ in principle from the true machine gun only in that the trigger must be pulled for each shot, and of course in the absence of the cooling and magazine features of the machine gun or automatic rifle.

Every civilized nation has experimented with military rifles of this type. No rifle came up to the scratch in pre-war days in all the points of simplicity, endurance and reliability. Now the demands on the rifle in the way of ease of cleaning and care and immunity to abuse and mud and grit are greater than in the days before the war. The need for the self-loading rifle is shown more plainly than ever—and the satisfactory rifle to fill the need seems farther away than ever.

Rifles that do the work of breech manipulation are divided roughly into two classes—the recoil operated and the gas operated. Machine guns follow the same classification, and are about evenly divided in actual number now in operation. The Maxim, the standard German machine gun, is recoil operated. The Benet-Mercier, the Lewis and the Colt are gas operated.

Recoil Operated Rifle

The sporting rifles sold to hunters are confined strictly to the recoil operated type, the list taking in the Remington, the Winchester and the little known Sjogren of England. The designer of the recoil-operated, self-loading—often miscalled automatic—rifle is confronted with the difficult task of both locking his rifle firmly against the thrust of the cartridge in the chamber, and yet utilizing that push to operate the mechanism of the rifle. If it is permitted merely to oppose a heavy unlocked bolt and a powerful spring to the backward push of the cartridge, then the task is easy, and we get what is called the "blow-back" type of weapon, a type including the familiar and successful Winchester self-loading rifles and various automatic pistols. In this type there exists a necessarily delicate balance between backward thrust of the cartridge case in the chamber, and the weight of the bolt and push of the main spring or retractor spring behind it. If the bolt and spring offer inadequate resistance then the speed of recoiling parts will be too great and there will be an escape of powder gas at the breech, not to mention the probability of blowing the cartridge case in half because the back portion would try to back out under gas pressure, while the forward and thinner one remained glued to the chamber walls by the same lateral powder pressure.

If the bolt and spring offer too much resistance, then the rifle will merely not function. Any overload or any serious obstruction in the bore, tending to raise the chamber pressure, would destroy this balance and so the refusal of military boards to countenance this type of action. However, it works nicely in arms of the sporting sort.

While necessitating a clumsy barrel cover, the Browning plan of recoil-operated rifle is thus far the most practical and one much copied by "designers" of foreign rifles of the military automatic type.

In the Browning plan, used in the Remington big-game series of self-loaders, the recoil of the fired cartridge drives backward the breech bolt and the barrel, firmly locked together, the barrel sliding in guides provided therefor. The backward motion compresses the retractor and main springs. At the end of the travel, which is about the length of a cartridge, a trip releases the lock between bolt and barrel, the heavy retractor spring drives the barrel forward to position again, ejecting the fired case, while the breech bolt is momentarily held back. A fresh cartridge rises into the path of the bolt, which then flies forward, carrying the new cartridge into the chamber, and locks itself by the turning of the bolt head into locking shoulders, as with the Mauser hand operated rifle. Here the delaying action of barrel and bolt sliding together serve both to prevent the undesirable unlocking of breech bolt while powder pressure is in the chamber, and to compress the requisite springs to carry out the reloading and closing sequence of actions.

In the Sjogren there is a heavy unlocking bolt on the breech bolt proper, arranged to slide freely in a line with the bore. On discharge the sliding bolt remains stationary, the rifle sliding beneath it until, at the end of the travel, the bolt unlocks the breech bolt proper which then opens under the reduced powder pressure and operates like the bolt of a straight blow-back rifle—sliding backward, ejecting the fired case, cocking the striker, compressing the retractor spring, and finally closing again on a fresh cartridge fed up from the magazine. Here the sliding unlocking bolt serves merely to delay the unlocking of the breech bolt until the powder pressure is off the head thereof.

The Browning plan is used on the Danish Schoeboe rifle submitted in military form to our War Department in 1909. The same scheme is used in the case of the Swedish Kjellman rifle submitted in 1910.

The Forward-Moving Barrel

A third application of the recoil operated principle is the forward-moving barrel idea, seen in the Swartzlose automatic pistol, sold in this country prior to the war. Here the "drag" of the bullet against the light barrel is alleged to force the barrel forward to the limit of its travel, compressing the retractor spring and cocking the arm, whereupon the barrel backs into place on a fresh cartridge that rises in front of the bolt and the arm is closed for firing. As a matter of fact the pistol in part backs away from the barrel much as the Sjogren rifle backs away from the sliding locking bolt. This is proved by the fact that if the firing hand is placed against a wall and the trigger is pulled, the gun will not function; the backward jump of the pistol has really more to do with the functioning of the gun than the actual forward motion of the barrel.

A highly successful automatic military rifle, invented by Sir Charles Ross, of Canadian Ross fame, and operating on the forward moving barrel principle, has been submitted in various forms to the Ordnance Department, and evidently contained much that had merit inasmuch as the arm has been altered to conform more to their demands. While there is not the slightest disposition on the part of the barrel of a gun to move forward when a cartridge is fired in its chamber, there is much willingness on the part of the rest of the rifle to recoil back away from the barrel if the latter is not firmly connected to the arm, and so it is entirely possible to make a rifle function by having the barrel stand still in its guides and let the rest of the arm recoil away from it. The effect is that the barrel slides forward—as would be the operation were the gun loaded by hand.

Gas Operated Rifles

All devices depending on recoil, however, are more or less clumsy and complicated compared to the simple plan of taking a little gas from the barrel and using it to operate a gas-engine type of miniature piston in its cylinder below the barrel. This is the operating principle of the Benet-Mercier and Lewis guns. The Colt uses gas, but lets it impinge on a lever hinged below the barrel and working downward through a portion of a circle on its hinge.

Some years ago, a self-loading sporting rifle of this type was put on the American market, but owing to various political difficulties in the factory itself rather than to any fault of the principle, this rifle is no longer made. Here the gas was taken out of a very small "port" bored in the lower portion of the barrel 20 inches or more from the breech. On the passing of the bullet, the gas following at high pressure passed down through the little pin-sized port into a cylinder lying below the barrel, and there it impinged upon the head of a piston and drove it backward until the piston passed relief ports cut in the cylinder and the gas could escape into the air. The backward motion of the piston was of course translated into the various motions necessary to unlock the breech bolt, drive it to the rear, cock the striker, etc. A valve at the port below the barrel regulated the amount of gas passed into the cylinder, avoiding excessive slam of working parts by high gas pressure, and yet permitting a trifle greater gas escape in case cold parts or grit required more force to operate the rifle.

This principle is purely the utilization of a miniature gas engine, deriving its charge from the gas behind the bullet. The small portion "borrowed" had no effect on the ballistics of the arm. Such gas operation permits the use of the simple and strong bolt of military type.

It is absolutely safe in that the operation of the rifle cannot commence until the bullet passes the port well up the barrel and that means that its exit into the air is then a matter of time almost too short to measure.

General Mondragon of Mexico designed a rifle on precisely this principle for the Mexican army just prior to the Madero revolution, and a number of such rifles were made. He used the backward drive of the piston to revolve a military type of bolt through an eighth turn as a soldier would do by hand, freeing the lugs from their engagement with the shoulders in the receiver and driving the bolt to the rear. This gas-borrowing principle is also used on the experimental British Laird Mentyene Degaille rifle, the Farquhar-Hill rifle of converted Lee-Enfield type and on various experimental rifles built by our own arsenals for experiment prior to the war.

The objection to the gas operated type of rifle is the slight tendency for the working parts to corrode from the gas used to move them, and the slightly greater difficulty in keeping the bore clean, due to the creeping up of corrosion from the unreachable gas-port in the barrel. Care can prevent this trouble.

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Any such rifle could be easily converted to straight machine gun automatic fire by installing a cam bolt to turn down the sear out of the path of the firing pin and let it return against the primer each shot; but with the light weight of the rifle the rapid sequence of shots would "bounce" it all over the place and the limited magazine capacity would make this sort of fire—400 to 600 shots per minute—entirely useless in that it would empty itself in a second or so. Many an incautious experimenter with self-loading sporting rifles has got the trigger mechanism out of order, and had the rifle remark, "Pra-a-a-a-p," with the entire magazine the first time he pulled the trigger. It is an experience more surprising than pleasing.

The ideal rifle of this self-loading type would permit the simple manipulation of the bolt by the soldier for slow fire without compressing each time the powerful retractor spring, which is somewhat of an effort and which would make the manipulation of the rifle even slower than was desired.

Practically any rifle of this type can be fired at an astonishing rate of speed. Five shots can be fired in two seconds without trouble, a 20-shot magazine can be emptied in as many seconds with fair accuracy. Wherefore the self-loading military rifle, to permit the utilization of its rate of fire, must have ample magazine capacity—not less than 15 rounds, preferably 20 or 25, clumsy as it might make the arm.

At a reasonable estimate the fire of a given number of men with such weapons and large magazine capacity would be equal to the fire of three to four times their number armed with the present type of hand-operated rifle, if the occasion was stopping a rush by a close-at-hand enemy.

But the speed of fire and consistent working are, alas, not all that are necessary for the successful rifle. It must be capable of being quickly taken apart for cleaning and the reduction of jams, must have few parts and those strong, must be immune to grit, water and mud—must in short be nearly as simple and easy to care for as the present universal Mauser type. Because such a rifle had not arrived by 1914 the British adopted their 1914 Enfield. Because it had not arrived by 1914 every nation in the war is still using the manifestly inadequate and slow and out of date Mauser type of bolt rifle to check rushes where the utmost speed of fire is called for.

The American Cutlery Industry

MANUFACTURERS of cutlery in the United States total about 100, which is less than half the number similarly engaged in Sheffield, England, alone. These figures, however, afford no clue to the comparative output of the two countries because the multitude of very small makers in Sheffield has no counterpart in the United States. The conditions differ also in that very few American manufacturers attempt to supply all descriptions of cutlery. Specialization is the rule with them, whereas in England it is the exception.

Only about twenty American firms make ordinary razors, and most of these supply no other kinds of cutlery. The manufacture of safety razors is a distinct branch of the trade occupying 26 makers of whom only three or four make anything else. The manufacture of scissors and shears engages more than thirty firms.

Before the war the United States imported a large quantity of cutlery, especially razors and cutlery parts from Germany, and butchers', pocket and "article" knives from Sheffield. The American export trade in general cutlery was negligible, but American safety razors and shears had a good sale in Britain, Canada, and Australia. At that time the use of stainless knives was making rapid headway in the United States, Sheffield supplying very large quantities, but this business was closed down nearly a year ago when the British Government prohibited the use of chrome steel in the making of cutlery.

It is claimed that the United States now leads the world in quality as well as in quantity of cutlery, and that with German and Austrian cutlery eliminated by the world war, possibly never to return, and with productive facilities and skilled labor in England at a low ebb, the United States has stepped into a leading position.

Cooking Corn Cobs

The Promised Utilization of One of Our Greatest Waste Products

WE are living at a moment when the greatest interest attaches to the conservation of resources and the utilization of waste materials. We are making every effort to insure that the systematic discarding of potential values so characteristic of nineteenth century industry shall cease. And one of the greatest potential values for which we have not heretofore found a use is the much despised corn cob.

The United States is the world's greatest producer of this cereal. Our annual corn crops range from two and one-half to three billion bushels. Expressed in bulk, this is about equal to our crops of all other cereals combined, and represents at least seventy per cent of the world's production.

For every bushel of corn, there is approximately one bushel of cobs which, however, weigh only about one-third as much as the grain. These cobs are not now utilized to any extent. They have a certain value as fuel, and they have been used as an ingredient of stock feeds. They contain, however, little or nothing that is directly available for animal nutrition. Since, therefore, they represent an almost total waste, corn cobs constitute, in view of the enormous amounts in which they are produced, perhaps our greatest agricultural waste product. But from the chemical standpoint, they represent a very valuable source of material from which many useful products could be successfully obtained on a commercial scale, if we but knew how to go about it.

Work recently done by F. B. La Forge, of the United States Bureau of Chemistry, seems to point the way to a complete solution of this problem. It is of interest first to note that, as so often happens, Mr. La Forge was precipitated quite by accident into the study of the field in which he appears to have done such good work. He was engaged in another investigation altogether—one in which he required considerable quantities of the wood-sugar, xylose. In accordance with accepted methods, he prepared this by treating corn cobs with sulfuric acid. While engaged in his work with the xylose thus obtained, the idea presented itself to him of deriving from it the acid base of baking powder; and as this would involve its utilization on a large scale, his interest was of course aroused to the possibilities of producing it commercially upon such a scale. But since the manufacture of xylose calls for only a small part of the cob, the most casual attack upon this problem could not fail to draw attention to the more inclusive one of finding a commercial application for the whole cob. The results of Mr. La Forge's investigations into this very significant by-way of industrial chemistry, while as yet unpublished, have already formed the subject of a talk given by him before the New York Section of the American Chemical Society; and it is from this talk that the following account is abstracted.

There are four principal products which may be derived from the corn cob. First comes a colloidal material consisting chiefly of a modified form of xylose, and which is obtainable to about thirty per cent of the original weight of the cobs. It is immediately available as an adhesive in the paper box industry, in bill-posting, labeling, etc., where its use in place of starch, dextrine and flour paste would make possible an enormous saving of these foodstuffs. After this substance has been removed from the cob, the next items obtained are about five per cent in weight, of true xylose, and an indeterminate amount of acetic acid. Finally, the balance of the cob is at this point reduced to a very finely divided cellulose, which for many purposes might be expected to replace cellulose from other sources. Its physical state is such that it is capable of taking up unusually large amounts of liquids, syrups, etc.; so it could certainly be employed as an absorbent for the molasses in stock food, while many other uses would doubtless develop. The discoverer suggests that it might be available as a base for dynamite manufacture.

While the methods for obtaining these four principal products from corn cobs have not yet been tested out on a large factory scale, they are at least out of the laboratory stage, since the work is now carried on by means of autoclaves, powerful presses, centrifuges, and other equipment of corresponding magnitude.

The first stage of the process is the preparation of the adhesive material. For this, the cobs are placed in a copper-lined autoclave, with just enough water to cover them, and are then subjected to heating at suitable temperature for about an hour. After cooling, the autoclave is opened and the contents subjected to strong pressure to expel the liquid from the undissolved solid residue. This liquid is then evaporated to a syrup in the open, and the product is ready for use at once. The whole process reads so very like an ordinary job of cooking that it must help impress upon us that, after all, cooking is just a question of chemistry—or, perhaps better, that chemistry is, after all, nothing but cooking with a college education.

For the recovery of the xylose which is responsible for the whole development, the solid residue from the first step is heated again in the autoclave, just as before, except that in this case about two per cent of sulfuric acid is added to the water used. The result of this cooking is an acid solution containing the desired xylose; and this is evaporated, in a vacuum, to a thick syrup which, upon being left to stand, deposits the xylose in good crystalline condition. Here again, it will be observed, we have perfectly good cooking terms and procedures. But the good old fashioned cook who separated her precipitates by skimming or draining or straining is left completely in the lurch by the up-to-date chemical cook. The latter, after a suitable length of time, whirls the acid mother liquor about in a centrifuge a few times, and separates the crystalline xylose in this more effective fashion.

It will be seen that, in this process for obtaining xylose sugar from the corn cob, we have just about the same procedure as that employed in recovering the crystalline substance from the juice of cane sugar. In fact, the immediate product is almost pure white and greatly resembles cane sugar in appearance. It is, however, only about half as sweet. As suggested, its chief use is not as a sugar, but rather as a starting point in the preparation of gulonic lactone for use as a baking powder acid. The procedure here has been fully developed, along two lines, either of which appears to be quite feasible commercially.

An alternative use for the large amounts of xylose which would become available if the manufacture of corn-cob products should be undertaken on a large scale would be its conversion into xylotol by reduction. This substance, a polyvalent alcohol, has almost the same physical and chemical properties as the more familiar glycerol and could serve in many cases as a substitute for the latter. Work on the commercial reduction of xylose to xylotol is about to be undertaken.

In the operation last outlined, acetic acid is obtained with the xylose. The centrifugal separation does not distinguish between it and the balance of the liquid; but it can be recovered by allowing the steam from the autoclave to escape through a condenser.

We come now to the fourth product, and the final one so far as the mere reduction of the cobs is concerned. This is the crude cellulose which remains after the extraction of the xylose and the acetic acid. This material represents about fifty per cent of the weight of the cobs, and is simply a highly porous and disintegrated form of cellulose. It contains a brown material which may for most purposes be disregarded, but which, when necessary, may be removed by leaching with dilute alkali solution, since it is alkali-soluble. This treatment yields a material which is almost wholly white. The possibility of uses based on the ground of its absorptivity has already been suggested; and these of course are direct, without further preparation. Its principal use, however, would be in the further manufacture of glucose. The method advocated for this is not at all new, being but an application of the very old process of Bechamp.

The press cake from which the xylose has been removed is washed, dried and ground. The resulting flour is mixed with enough 75 per cent sulfuric acid to form a stiff dough. The only feature of this that would be at all strange to the farmer's wife would be the use of a deadly poison to wet the dough. This dough is allowed to stand for some hours—obviously to undergo the changes which are paralleled in the rising of the more familiar kind of dough. Then it is mixed with water and boiled for about an hour, after which the undissolved solid material is filtered off with a filter press, and the sulfuric acid removed by an application of slacked lime, followed by another filtering to get out the resulting calcium sulfate. The neutral solution remaining from all this is evaporated, yielding a light brown syrup which crystallizes to a solid cake in short order. As a matter of fact, however, we err in calling this solution neutral; it should be so, but it isn't. There are traces of acid present, as well as a good deal of the calcium sulfate that escaped the filter. By treating it with decolorizing carbon before evaporation this state of impurity is partly remedied; while the amount of sulfate present is reduced to a minimum by filtering it just before it reaches the syrupy state—at the

(Continued on page 283)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Not a New Arm

To the Editor of the SCIENTIFIC AMERICAN:

I note with considerable surprise the article on "A German Substitute for Browning Rifle" with copyrighted photograph on page 215 of your issue for Sept. 14th. You are misinformed as to this being a new arm. I have one of them before me, identical with the one illustrated, complete with its stock-holster. I purchased this some ten or more years ago from a Broadway sporting goods house, whose name, together with that of the maker, "Waffenfabrik Mauser, Oberndorf am Neckar," is stamped on the frame. The box magazine takes ten 7.65 mm. cartridges; I was advised that another model was made taking 20 cartridges.

I have become so accustomed to regarding my SCIENTIFIC AMERICAN as infallible that I venture to make the above correction; as, I dare say, dozens of others have done by this time.

Lakewood, N. Y. J. W. PACKARD.

Cultivating Battle Fields

To the Editor of the SCIENTIFIC AMERICAN:

A consignment of SCIENTIFIC AMERICANS reached me in the last mail. I have been deeply interested in all of them, but gave considerable consideration to an article, "Can Shell-Scarred Battlefields be Cultivated?" appearing in the February 9th issue of this year. The question came to my attention very early in the spring and since then I have studied it to the best of my ability.

Upon entering a sector, troops examine the shell holes and craters to determine how recently or how extensively an area has been shelled. This is done by a consideration of the erosion which has occurred and the amount of vegetation growing therein. Considerable accuracy is attained in this manner in determining the activity of a front. I have never seen a shell hole considerably eroded without at least a few blades of grass and perhaps a poppy. I have inspected regions that have been "gassed" by all of the more common asphyxiating fumes used by the Germans. There is positively no indication of a permanent "poisoning" to the ground thus treated. At one time this last spring I had the leisure to examine soil under cultivation that had been considerably shelled early in the war. My attention was attracted by numerous circular plots more verdant than the average of the land. These plots were incircled by a ring of still more verdant grass. Thorough inspection showed that each one of these plots was a former shell hole which had been diligently filled and leveled by the laboring husbandman. Not that I approve of the practice, but land that has been torn and ripped by high explosives and shrapnel has been decidedly improved thereby.

The method of reclaiming around which No Man's Land has swung back and forth across has been discussed. The most practical method on a large scale would be to utilize the great "tanks" that will be thrown out of employment by the cessation of hositilites. But I do not believe this method will be much used. I have been on detached service as Chief Gardener in a village within the Zone of Trenches. In the absence of the civil populace, it was my duty to utilize the numerous gardens for benefit of the occupying troops. The gardens were pitted with shell holes and crossed by entanglements. Leveling the shell holes with short handled heavy French hoes was but a slight matter. No attempt was made to remove the wire entanglements because of their future possibilities. But, farther behind the lines, French peasants could be seen removing the stakes and wire, bit by bit. In this manner the land will be reclaimed. The trenches, artillery pits and dugouts are rapidly eroded by nature. In sections from which the Germans have been driven the patient husbandman has laboriously cleared the soil and planted it, with the hopes of refugees returning to the homes of their childhood.

During these days of strife and turmoil we may look forward to the Peace that must come, with calm confidence that Nature will be more bountiful in this blood scarred land than in all the rest of the world.

Co. E. 166 Inf. American E. F. ERNEST LOTZPOT.

"Toothless Saws in the Sixties!"

To the Editor of the SCIENTIFIC AMERICAN:

In the SCIENTIFIC AMERICAN of August 24th, 1918, appeared a letter from C. H. Roth, in which the origin of the toothless saw for cutting metal was placed as early as 1884. I am afraid it will have to be pushed even further back than that.

In December, 1861, I enlisted in the "Curry Dragoons" a cavalry company, which was then quartered in cotton compress-warehouses in Mobile, Ala. There were building here, near our quarters, two wooden gunboats for the Confederate navy, and my company mates, including myself, frequently visited the yards, where the work of building these gunboats was to be seen.

To my surprise I saw in one of these yards a circular disk of steel, without any teeth, but perfectly smooth, being run at high speed, and used to cut in two, bars of iron for the gunboat.

On April 2d, 1865, General Wilson's Cavalry Corps captured and burned the city of Selma. Among the buildings burned was the C. S. Naval Foundry, in which were a large number of heavy guns, in all stages of completion. The ground on which the Naval Foundry stood, and all the guns, machines, and unburned materials and tools of every kind, were condemned by the U. S. Court, and sold under its decrees.

At the marshal's sale, all the heavy guns were bought by a man and shipped away, but to handle these large guns was too difficult, so he rigged up a steel disk, driven by a steam engine, at a very high speed; and with this smooth disk he sawed up the guns into many pieces, so that they could easily be rolled along by one man; and in this way he shipped off all the iron of the former naval foundry. I saw this smooth saw in operation several times, and it cut through a large gun, apparently as easily as though it had been wood.

Until some one can show that the "toothless steel saws" were used *before* the Confederate mechanics used them, as I saw in 1861 and again in 1866, I shall claim for them the credit of having invented the "toothless saw."

Selma, Ala. SAM'L WILL JOHN.

The Essen Coal Fields

To the Editor of THE SCIENTIFIC AMERICAN:

Once upon a time, so legend runs, two Germans, strangers to each other, sat at the same table in a café. One of them had a very red nose. After awhile the other queried: "Why is your nose unlike a Krupp cannon?" Mr. Red Nose was nonplussed! "Because," his table companion continued "your nose comes from *trinken* and a Krupp cannon comes from *Essen!*"

Now there is a lesson in this at the present moment when peace is looming up under the guidance of great Ferdinand Foch. For why do Krupp cannon come from Essen? And the answer is simple: Krupp cannon come from Essen because Essen is in the center of the great coal field of Germany. It is, however, a remarkable fact that in the many suggestions about what should be done when the German people finally cry "*Kamarad*" one hardly ever finds, except in one small book by Dr. C. W. Macfarlane, a reference to the Essen coal field.

And yet the Essen coal field is perhaps the most important asset toward keeping peace in future. Take it away from Germany together with the Lorraine iron mines and there will be no more Krupp cannon. And for my part I pray that when the Allies dictate the peace terms at Berlin, they will hand over the Essen coal field to Belgium. That would indemnify to some extent poor Belgium. And it would also for all time draw the fangs and extract the claws of the Hohenzollern monster.

Philadelphia, Pa. EDWIN SWIFT BALCH.

Recent Enemy Aircraft

How the Germans Make the Most of Information Obtained Through Captured Allied Planes

By Bertram W. Williams

ALTHOUGH one has the highest respect for the Germans for their inventiveness of new forms of destruction, it is noticeable that their development of heavier-than-air machines seldom embodies any ideas along new and startling lines. Nearly all the successful German airplanes of the last three years show strong evidence of the influence of various captured Entente aircraft.

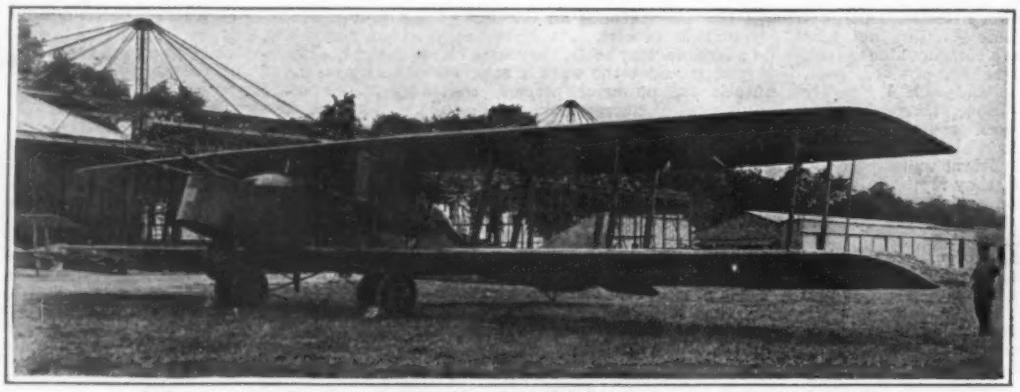
Take for example the Fokker monoplane of the 1915-16 period. It was really nothing more than a copy of the French Morane adapted for warfare by a few slight alterations. It is true that its designer was a Hollander by birth; nevertheless it is typical of the Teuton mind that it is quick to seize upon the fruits of another's brain, and, with a few subtle changes here and there, to produce an imitation more often than not highly superior to the original design.

The small Albatros D-III, which has been the chief German combat machine on the western front for some time, shows strong points of resemblance to the French Nieuport, although the two machines have structural peculiarities of great difference. Both these types, however, may be classed as obsolete; the former having—as far as is ascertainable—been replaced by the much stronger and more aerodynamically efficient S. P. A. D., while the German *Tagd-Staffeln*, or pursuit squadrons, are now using a small triplane manufactured by the Fokker people. This is evidenced by the fact that the dean of the German pilots, von Richthofen, who was killed on the western front only the other day, was flying one of these machines at the time of his death.

The triplane idea on a miniature scale is nothing new, the Curtiss firm over here having built a very neat looking and efficient model two years ago. Although the three tiers of planes give a large ratio of lifting power, yet there must always be a certain increase of head resistance due to the extra row of interplane struts and their multifold bracings of wire, all of which must bend to lessen the horizontal speed of the machine. The latter desideratum is not, perhaps, so highly important as is generally supposed. Climbing power and the capability of doing aerial gymnastics are of far greater value in the modern battleplane. The remarkable stunts employed by all successful fighting pilots call for severe and sudden reversals of stress and strain, and a machine must be at the same time light enough to maneuver easily, and strong enough to carry a powerful engine of considerable weight. Whether the multiplane will solve the problem of these seeming contradictions remains to be seen. The small Sopwith one-seater triplane employed by the British last year with no little success seems to have been the chief inspiration of the latest Fokker machines. A description of a captured German *Kampfflieger* triplane, similar to the one on which von Richthofen met his death, appeared recently in a French journal, and makes interesting reading for every student of modern aeronautics.

The great disadvantage of the Albatros D-III type was its incapability of maneuvering in a small radius, due probably to the very heavy Mercédès motor. The French and British machines, such as the Nieuport and Sopwith, although somewhat slower, were superior in "stunting" tactics, especially in a *melée*, where several aircraft were engaged. Evidently the new Fokker triplane is an attempt to overcome the drawbacks of the Albatros, while retaining its good points.

French and English experts studying the machine from an engineering point of view do not seem to be particularly impressed with its general appearance. The weight of the Albatros empty was about 1,470 pounds; the Fokker biplane captured only weighs 829 pounds, or little more than one half. These figures, of course, have very little to do with performances, as a heavier and therefore stronger built machine can naturally be fitted with a more powerful engine. The Germans claim that the Fokker triplane is capable of climbing 15,000 feet in 17 minutes, which, if true, is certainly a remarkable performance. None of the three planes are of the same dimensions, the top one being the longest, and that only about 25 feet overall; the middle and lower both tapering to a lesser spread, although the chord, or breadth, of all three is the same. The total wing area is about 205 square feet, which seems very little for a multiplane machine. Probably to lessen head-resistance there are no bracing cables or wires of any description whatsoever attached to the wings—an omission unknown, even in monoplane construction. Whatever its advantages, it must have a very deterrent effect on the general strength of the machine. This is a fault that the Germans are not usually prone to; a certain ruggedness of construction and a good allowance of a factor of safety being apparent in most of their designs. Critics speak of the Fokker triplane as being one of the poorest of modern German machines. Certainly all of the products of the same firm have had a bad name for breaking in the air. A feature of interest about the same machine is the enormous streamline axle of the landing chassis, so wide that it forms what is practically a fourth lifting plane. The fuselage is of tubular steel covered with linen fabric and hexagonal in shape. There is a large fixed tail plane contrary to the usual Fokker practice of elevator flap alone. There is no vertical fin plane. The 110 horsepower Oberursel motor is a copy of the well known Le Rhone rotary engine. Two synochronized Spandau machine guns are fixed one on each side of the engine.



A German long-distance night bomber of the Friedrischafen type, recently brought down intact by the Allied forces

Another German machine of interesting design seen recently on the French front is the Hannover two-seater.

View forward from the rear gunner's cockpit in the A. E. G. bomber, showing the pilot's and the forward gunner's posts

Correct details are difficult to obtain, most of the observers differing in their descriptions, and no official account seems so far to have been published. The chief peculiarity of this machine is the biplane tail, one elevator being above the fuselage, the other below. This is a decidedly unorthodox point, and must have some advantage or it would not be adopted. Probably the smaller tail surface area on a fighting airplane affords less cover for a pursuing machine. Also, it is quite possible that the double surface at the rear gives increased stability and an added ease of control.

In their large bombing planes the Germans have specialized for some time; though here again they have not been above copying from the English Handley-Page and the Italian Caproni in many important particulars. An official account of a Friedrichshafen *Riesenflugzeng* or "Giant plane," recently captured by the Allies, has been issued by the British munitions department. The total weight of the machine with crew, armament, and bombs is 3,930 kilos (considerably over four tons). The machine is a propeller biplane with three rows of interplane struts on either side of the fuselage. The span of the wings is 78 feet, and the total area 934 square feet. The engines of which there are two, one on either side of the fuselage, are 6-cylinder Mercédès of 260 horse-power each. Very interesting are the internal fittings of these huge craft. There is a small roofed-in section behind the cockpit forming a tiny cabin. On a dashboard in front of the pilot are the various engine controls, comprising an independent throttle lever for each engine, a revolution counter, spark controls for both magnetos, a grease pump, gasoline regulator, and various other "gadgets." The flying controls do not differ in any particular way from those of the ordinary machine, the Deperdussin wheel type being adopted. Naturally, they are much more powerful, and by an ingenious system of springs worked round a small hand-winch close to the pilot's seat, the elevator can be locked in any position desired, thus relieving the pilot of considerable muscular strain when flying in a strong wind.

The armament consists of three Parabellum machine guns mounted on swivels, capable of being fired either horizontally or vertically at almost any angle. There are racks in the nacelle for carrying five 25-pound bombs, while underneath are two large tubular frames each capable of carrying a bomb of 660 pounds. These giant airplanes have a distinct interest in the fact that they are the forerunners of the commercial passenger and cargo aircraft of the near future.

The accompanying illustrations are of the Friedrischafen and the A.E.S. types, which are not as recent as those just described. However, these are being constantly improved.

All photos from French Official

Three-seater A. E. G. German bomber largely employed by the enemy for night raids

The Current Supplement

THAT psychological and physiological factors are of importance in anthropological investigations is shown in a paper on *Heredity, Environment and Civilization*, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2231, for October 5th, in which the influence of these factors in controlling human behavior is considered. Many allusions are constantly made, in our war reports, to the bombing guns that are so generally used in the trenches of France, but little of detail in regard to them has been published. The article on *The Stokes Bomb-Throwing Gun*, which is accompanied by a large number of general and detail illustrations, gives a very complete description of one of the most noted guns of this class, and tells how it was developed from a crude idea. The proposal to use steam engines, instead of internal combustion motors, for motor vehicles is frequently renewed, and many ingenious improvements in the application of steam lend force to the suggestion. A valuable paper on *Steam Engines in the Automotive Field* covers the question quite thoroughly. *Modern Cave Men* is a short note, accompanied by several interesting photographs, telling of the modern occupation of prehistoric grottoes in France that were once the dwellings of ancient cave men. *The Murman Railway* gives some timely facts in relation to the rather remarkable railway that connects the northern district of Russia, in which forces of the Allies are now operating against Bolshevist bands, with Petrograd. An article on *Ordnance* gives a brief history of the rise and development of big guns. *The Total Eclipse of June 8th, 1918*, gives an interesting account of what took place at one of the observing stations in the west, and is accompanied by a photograph showing the corona during the occulation. *The Significance of Glass-Making Processes to the Petrologist* discusses some problems of interest both to the technologist and to the scientist. The paper on *Mycology* is concluded in this issue. *The Freedom of the Rhine* tells of another instance where Germany is threatening to disregard treaty rights, this time Switzerland being the helpless victim. Old treaties give Switzerland navigation rights on the Rhine, her only outlet to the sea, and these rights Germany proposes to nullify by constructing a number of dams across the Rhine.

In the Gas-Mask Factory

Where Fruit Stones and Nut Shells are Used to Protect Our Boys from the Poison Puffs of the Hun

THE modus operandi of the gas mask has been made sufficiently clear. In the beginning there was a good deal of popular misconception; the idea was quite prevalent that the mask operated by a process of physical exclusion, keeping out the noxious vapors much as a diver's helmet keeps out the water or as a sealed jar excludes the air. Under the flood of light thrown upon the matter by dailies, weeklies and monthlies of all classes, however, it is now generally understood that the mask is really a chemical machine, which filters out the foreign substances from the air, allowing the latter free passage. There is no place in trench warfare for individual oxygen tanks. Accordingly the gas mask is not a respirator providing an artificial atmosphere for the wearer to breathe; it is a sieve making the poisoned air about him fit for his use.

Collecting fruit seeds and nut shells for gas mask manufacture

In the beginning it was simple enough to design a mask that would do this. The Germans were using only chlorine gas, and this is a very active chemical; it will combine with almost anything in the world. It was easy to find a competent reagent for such a gas, and to place a sufficient quantity of it in the masks. But as the chemist made more and more of a specialty o the poison-gas field, and introduced more and more variety into his attack, an equally inclusive defense became necessary; and there deve oped a race between gas and mask, much like that between shell and armor. Now the attack would enjoy a temporary advantage, only to have the de ense forge again into the lead.

Obviously, a single mask is all that one soldier can well be expected to carry and use. So the defense is confronted with the problem of manufacturing one mask which will exclude all the vapors the enemy is known to employ or to contemplate employing. More even than that—if the defending chemist hopes to enjoy any peace of mind at all, he must seek a mask which will exclude all the poisons the enemy is likely ever to use.

This, of course, is to some extent an unattainable ideal. The unattainable can always be approached, however; so the mask makers at no stage of the game abandoned the search for a universal mask. Their attack upon this matter has been made along two distinct lines.

Early in the use of gas, before the full possibilities of the attack were recognized, the attempt was made to supply the wearer of the mask with a separate reagent for each separate gas employed by the foe. But as the number of gases available for the attack increased, it became evident that this procedure had decided limits; it would require a whole chemical laboratory to meet, on this basis, the list of German gases which appeared in one of the recent issues of the SCIENTIFIC AMERICAN. So the defense was directed into another channel, and a single universal reagent was sought—a substance which, placed in the mask, would react with any poison gas that might be encountered, but would pass pure air without any alteration.

Now this is a pretty large order; and complete attainment is doubtless out of the question. But the chemist has a resource which we have not yet touched. In order to secure protection against the hostile gases, the substances in the mask need not ne cessarily react chemically with these, in the ordinary sense of that word. It will be quite sufficient if they absorb them, as water absorbs salt or sugar out of a mixture containing these together with other insoluble substances. Or perhaps an even more illuminating analogy would be with substances that deliquesce, like calcium chloride. This chemical absorbs water from the air so freely that it finally dissolves in the fluid thus taken up, so that a pinch of the dry powder in a dry saucer will be converted, over night, into a large drop of water in which the original solid is dissolved.

So, parallel to the search for the universal reagent, we have the search for the universal solvent or absorbent —a substance which remains indifferent to the presence of air, but which will absorb out or dissolve out of air any foreign gases that it may carry. There are various substances which possess in greater or less degree this power of absorbing gases—the platinum sponge employed in the manufacture of sulfuric acid is an example raised to the nth power. But not all of them can be induced to omit from their sphere of influence air, the commonest of all gaseous media, and the one which must receive free passage through the gas mask. Carbon, however, and in particular carbon in the form of charcoal, meets the situation nicely. It does not absorb air, and it does absorb other gases freely.

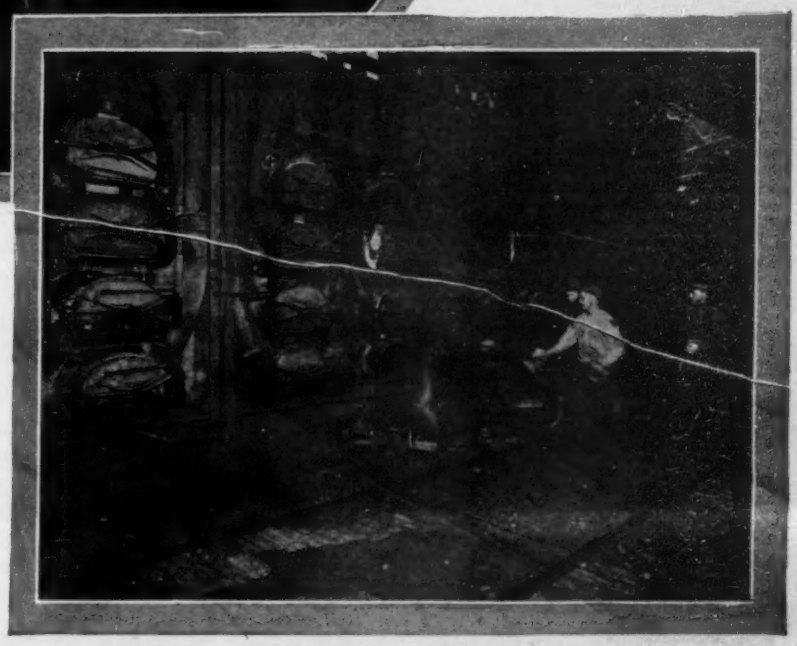
But charcoal occurs in various forms, according to the particular vegetable source from which it is manufactured; and the various forms possess varying degrees of gas absorptivity. After exhaustive tests, the chemists find that first rank must be given to charcoal produced from peach stones, the pits of apricots, prunes, plums, olives and cherries, date seeds, and the shells of brazil nuts, hickory nuts, walnuts and butternuts. What tomorrow may bring forth in gas mask manufacture no man can say, for the last thing that a chemist would think of doing would be sitting down with his hands crossed, in confidence that the final word had been written in any of his chapters; but today we make our gas masks with charcoal from the sources mentioned.

Testing the density of the charcoal members for the masks

For every soldier in the fight there has to be a gas mask. Four million soldiers does not mean four million gas masks, because all the four million are not destined for actual fighting, and because those who are so destined are not all fighting at once. But every mask takes seven pounds of seeds and shells, and a million masks—a reasonable minimum—means seven million pounds of the raw materials. Thirty-five hundred tons of fruit pits and nut shells is a great quantity; it is a quantity that cannot be obtained save by the coöperation of every consumer of nuts and fruit. It is for this reason that the Government has appealed to all of us to save these items out of the garbage pail and turn them over to the Red Cross agent who will collect them. Other shells and pits would constitute adulteration, and so must not be mingled with the ones enumerated. Especial emphasis might well be placed upon this clause as it applies to cocoanut shells; for these are being conserved, too, for gas mask manufacture. The charcoal from them is available; but it is different from that from the other sources, and requires different treatment; so the cocoanut shells must be kept separate.

The process of manufacturing the gas masks would make a most interesting story; but during the continuance of the war it is of course a story which cannot be told. Our pictures merely show several of the most obvious steps. It is clear enough that the pits and shells must be collected, and turned into charcoal in furnaces of a standard type; and the enemy will hardly get much aid or comfort from the knowledge that before the unit containing the charcoal is allowed to go into a mask, it is subjected to a severe preliminary test, to determine whether its charcoal screen is of sufficient density. But beyond this, picture and story cannot go far.

We may, however, still say a word about the inspection of the finished masks. This is done by a specially selected force; and since a mask, once passed by this force, will not be tested again until some American soldier puts it on in the face of a gas attack, every effort is made to keep the inspectors keyed up to concert pitch. Sometimes this may even be carried to extremes; we learn on good authority of one serious-minded inspectress who worried so conscientiously lest a defective mask be passed by her to cause the death of one of our boys in khaki, that she lost five pounds a week for an incredible period, and had finally to give up the work to someone whose mental processes were less intimately connected with physical reactions. We are also told that as an inducement to the inspectors to do good work, each of them is from time to time sent into a gas chamber protected by a mask selected at random from those which he has passed himself.



The modified coke-ovens in which the nuts and shells are burned into charcoal

A New Substitute for Leather

DUE to the great and growing scarcity of leather, experiments to find a good substitute, which were known already in pre-war days, have multiplied like the proverbial green bay tree. Most of these substitutes have been more or less unsatisfactory. A patent, however, has just been filed in England by Mr. Rudolph Obrist-Doos, of Lucerne, Switzerland, who for the past two years has devoted himself to the discovery of a good waterproof leather substitute. After a thorough study of all existing methods he came to the conclusion that, without the use of animal tissues, it is impossible to obtain any good waterproof composition. Mr. Doos has succeeded in producing a composition which, on test, has been found to be fully equal to leather; it is perfectly waterproof, flexible and durable and corresponds to all the requirements made of it. Use is made of the bladders of animals which, while raw, are stretched in a machine and dried. In this way they acquire a smooth surface on which desired colors can be applied. By means of a special process (fulling and tanning with vegetable tanning materials), they are so prepared that they become perfectly pliant and waterproof. After this treatment the smooth pieces of bladder are, by means of a suitable adhesive substance, so pressed upon one another that the leather thus obtained can stand any degree of moisture. Several pieces can also be pressed together, without or with felt so that different thicknesses can be obtained.

A New Bottle Stopper

IN order to replace the hitherto absolutely indispensable cork stopper a certain firm of specialists has, apparently, succeeded by the use of soft kinds of wood (beech, lime, ash, poplar, etc.) which are shaped to form stoppers and are said to possess all the elasticity of cork. The new stopper is a hollow body formed in such wise that only its upper hollowed, and consequently elastic, portion bears against the walls of the bottle, while the lower solid portion does not come in contact with the neck of the bottle. The elasticity of this stopper is so great that, when inserted by hand or by machine, the neck of the bottle is not injured in any way. The solid portion of the stopper is tapered off so that, should the neck of the bottle not be quite round, the stopper will easily adapt itself to the shape of the neck. The stopper is inserted in the same way as any other cork.

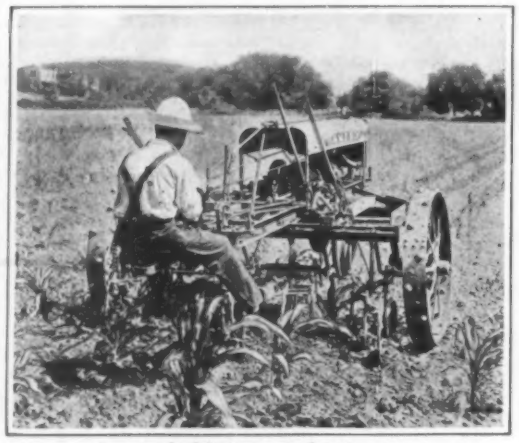
Mechanical Equipment of the Farm

Latest developments in agricultural machinery and practical suggestions for the farmer

Conducted by HARRY C. RAMSOWER, Professor of Agricultural Engineering, Ohio State University

The Motor Cultivator

THE writer recently witnessed a demonstration of motor cultivators in which six different types of machines were exhibited. There is no question but that excellent work can be done with them. All but one machine cultivated two rows of corn. The speed could be so completely controlled that there was nothing left to be desired in that connection. More steady than a team could possibly be, the rate of travel could be suited to the size and condition of corn, soil, topography, etc. Three two-row horse-drawn cultivators were working the same field. It was difficult to decide which of the machines was doing the best job.



A motor cultivator covering two rows

Motor cultivator used in planting corn

All of the machines had ample power, but differed some in ease of control. In one type the cultivator gangs were mounted ahead of the motor so that the operator had a clear and unobstructed view of the work ahead of him. This is an item of no small importance either.

The investment seems large for a tool of its kind, yet it can be adapted to different kinds of work. One of the illustrations shows it drawing a corn planter. The manufacturers claim that it may be used for mowing hay, as well as for other haying operations, and for drawing the lighter tillage tools. These machines cost between $500 and $700, and will, no doubt, find a place in our modern farming, particularly in the large-farm area of the corn belt.

Increasing the Efficiency of the Kerosene Lamp

THE lighting of the farm house is one phase of country life that is too often sadly neglected. The common round wick lamp, the best of its kind, is no longer good enough for our homes. It falls as far short of what we really want and should have as did the tallow candle twenty-five years ago.

The accompanying illustration shows a round-wick kerosene lamp with a mantle suspended above the wick. This mantle is similar to ordinary gas mantles. Its use increases the efficiency of the light many times. Without the mantle the lamp would give about 18 candle power of light, with the mantle it will give 60 candle power. With the mantle, too, it will burn 52 hours on one gallon of fuel, whereas the ordinary round wick lamp giving less than one-third as much light will burn only 26 hours on one gallon of fuel.

The quality of the light from the mantle lamp is much better, too. Soft, white, and steady, it sheds a most pleasing light—a delight to read by it.

More troublesome? Yes. It must be carefully operated and kept scrupulously clean. The wick must be neatly trimmed and the burner not allowed to accumulate dirt. The mantle may last as long as six months, though six to twelve weeks is more like the average life. This lamp will bear investigation by those who are still using the common kerosene lamp.

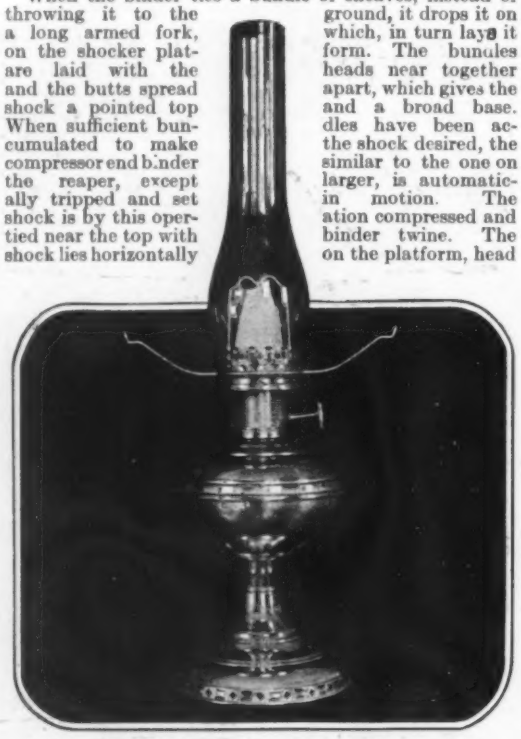
Saving Harvest Labor with a Shocker Machine

ONE of the farmer's most popular war-time labor-saving devices is the shocker machine, recently invented. This machine is estimated to have displaced more than 1,500 hired harvest hands the first year. It is attached in the rear of the reaper and binder, catches the bundles, forms them into a shock of from seven to eleven bundles each, and firmly sets this on the ground.

The illustration shows a scene on a Kansas big wheat farm, where heavy grain at the rate of fifty acres per day is being harvested with two reapers and binders, two shockers, drawn by a light farm tractor. If operated in the usual manner, it would demand about eight men to set the grain up behind these harvesting machines.

Several Kansas wheat farmers have been able to harvest from 100 to 150 acres of heavy grain, using the shocker machine, without extra hired help. The shocker works best on level land, but may be adjusted for rolling and hilly grain fields.

When the binder ties a bundle of sheaves, instead of throwing it to the ground, it drops it on a long armed fork, which, in turn lays it on the shocker platform. The bundles are laid with the heads near together and the butts spread apart, which gives the shock a pointed top and a broad base. When sufficient bundles have been accumulated to make the shock desired, the compressor end binder, similar to the one on the reaper, except larger, is automatically tripped and set in motion. The shock is by this operation compressed and tied near the top with binder twine. The shock lies horizontally on the platform, head forward, until it is bound and ready to be set up. The shocker platform is pivoted and, when the shock is ready to be discharged the platform is tipped automatically backward, at the same time the long arm or needle, which is still about the top of the shock, rocks backward, lifting the shock to an upright position, sliding it off and setting in on the ground as neatly and firmly as the most exacting farmer could demand.



Round-wick kerosene lamp fitted with a mantle

Anchoring Iron in Cement

FOR several years, since 1904, in fact, the well known laboratory for testing building materials at Lichterfelde, Berlin, has been investigating the strength and durability of iron anchorings sunk in mortar of various sorts. The tests have had in view the determination of the behavior of the iron in different kinds of mortar and also the degree of resistance to rust. The German technical journal *Beton und Eisen in Maneerwerk und Moertel*, gives a resume of the results obtained, which are as follows:

The first tests proved that flat iron is better than round iron for making anchorages of iron in cement, which agrees with practical observation. The resistance to slipping of the anchorage increases steadily for a period of five years, whatever the kind of mortars employed (mortar made of cement, of lime, of lime and cement, of plaster, etc.).

The researches with respect to rust demonstrated that the iron has need of a protective covering, in the masonry at any rate, unless it is embedded in pure Portland cement or in a mortar made of slag and cement; in all other sorts it is briskly attacked by rust.

The adhesive strength of the iron is not very marked except in cement mortars. A protective coating of red lead or of tar at first diminishes the strength of adhesion, the red lead being especially unfavorable in its effect. This action disappears with the lapse of time, but the protection against rust is correspondingly decreased. Neither rust nor galvanization greatly affect the strength of adhesion in mortar made of Portland cement.

German and American Copper

THE future effect on German trade of the intervention of the United States in the war, especially as regards copper, was recently discussed in a German paper. The writer recalls that in 1913 the United States exported 200,000 tons of copper to Germany, and he asserts that since the beginning of the war the copper production of the United States has almost doubled owing to the demand for munitions for the Allies. When this war demand has ceased, he argues, there must inevitably be an over-production of the metal in the United States, and no political enmity will induce the manufacturers under such conditions to refuse to deal with such a good customer as Germany. On the contrary, they will be in a hurry to recapture the German market, if for no other reason than to put a stop to the great development in the employment of substitutes which, owing to the scarcity of copper during the war, has made such rapid strides in Germany.

A Spring-tooth Harrow on Wheels

THE spring-tooth harrow vies with the disk in popularity in many sections of the country. It is considered superior to the disk in stony soils because the disk tends to ride on top of the ground, while the spring teeth will work around and under the stones. The tool here illustrated is a spring-tooth harrow on a truck. It is remarkable what penetration can be secured with this harrow. The truck adds weight and enables the operator to maintain an even depth, be that depth shallow or deep.

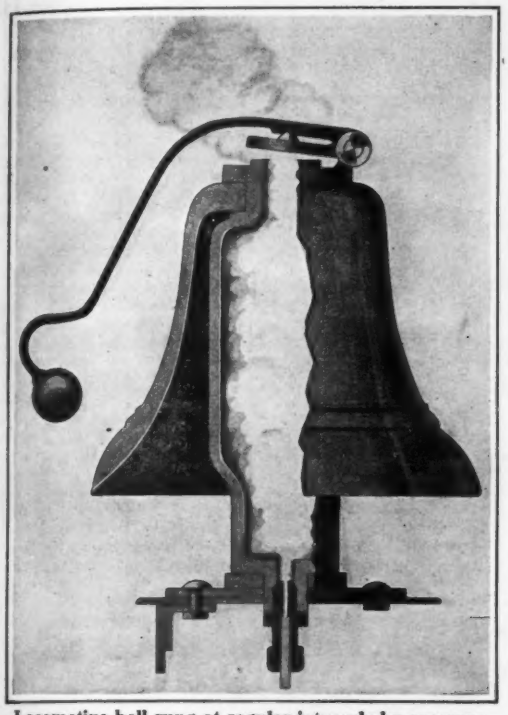
Another feature very much to be desired is that the operator may ride. It is no longer considered that a man is lazy if he is seen operating a riding tool; it is a question of conservation of man power, and if the workman can do equally good work riding as walking, by all means let him ride.

Spring-tooth harrow carried by a truck

The war-time harvester binds and shocks fifty acres of wheat a day

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



Locomotive bell rung at regular intervals by pressure of escaping steam

A Unique Bell on English Locomotives

WE illustrate an interesting British locomotive bell. It is an "automatic bell ringer," really a gong instead of a bell. It is rigidly mounted on a hollow stem into which steam is admitted through a closely throttled opening. The top of the stem is closed by means of flap valve which bears against the hammer.

Steam pressure is built up within the stem until it is sufficient to lift the weight of valve and hammer, whereupon it quickly escapes through the large opening, allowing the hammer to fall and strike the bell, the operation being repeated at same rate as long as a given flow of steam is admitted to the chamber. Obviously the rate of oscillation by the hammer varies with the rate of flow of steam admitted through the control valve, which gives the arrangement something of an advantage over our common type of bell, in that it can the better be used as a dependable emergency warning device.

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The electric wheeled chair installed at Bronx Park to release pusher men and boys for war work

The Electric Beach Chair

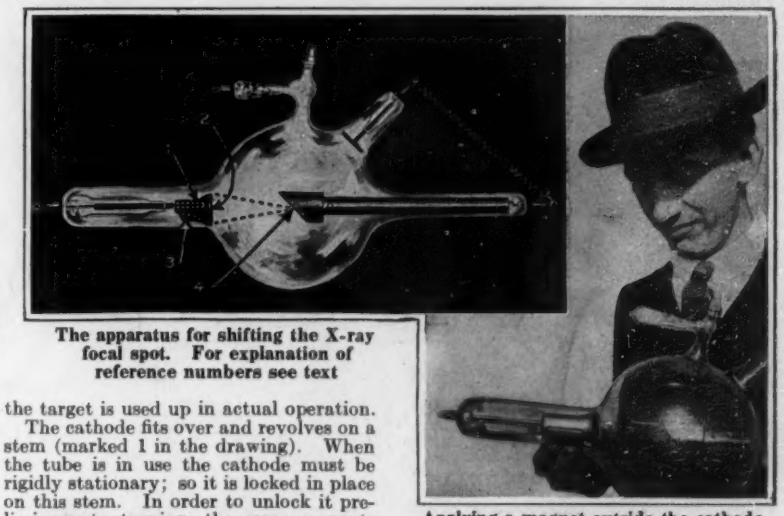
NEXT time you are at Atlantic City, Coronado, or Palm Beach, you will probably look in vain for the familiar beach chairs in which you have been accustomed to be wheeled along the boardwalk for so much an hour, plus a handsome tip. The work-or-fight order has got the boys and men who used to furnish the motive power for the chairs, and they are now busy winning the war on the battlefields of France or in the mines and mills of America.

But even so, you will not have to go without your ride along the beach. The worst inconvenience that will be yours will be that, if you are a stranger, you will have no human companion to serve as a butt for your questions. The New York Zoölogical Garden has been among the first to feel the shortage of chair-pushers; perhaps it has actually been the first to install a chair that will push itself. We illustrate the smart little electric vehicle which has taken the place of the "pushmobiles" at Bronx Park. It is suggested that aside from the commercial uses outlined above, this conveyance will turn out to be well suited for use at hospitals, by semi-invalids and old people etc.

Lengthening the Life of the X-ray Tube

IN the use of an X-ray tube, the bombardment of the tungsten target by the cathode stream eventually burns through the tungsten; and the rays, on striking the copper anode beneath, cause copper vapor to be thrown off. This ruins the tube for picture work. The damage can only be repaired by moving the cathode so that the focus will fall at a different spot on the target; and heretofore this has always meant that the vacuum must be destroyed in the tube, the cathode moved by hand, and the vacuum restored. All this takes time, and the cost is considerable.

T. B. Rider of Los Angeles has devised a means of shifting the cathode focal spot to a different point on the target in a few seconds and without any cost. The whole operation is carried on without disturbing the apparatus in the least, save in the respect in which disturbance is sought. The secret of this lies in the steel blocks which Mr. Rider arranges about the cathode of his tube, during the original process of setting it up. Given these, he can, by placing a powerful semicircular magnet on the outside of the X-ray tube, just opposite the blocks of steel, turn the cathode by means of the magnetic force. But the cathode is mounted eccentrically, so that the action of the magnet causes it actually to shift its position in the tube, instead of merely rotating about a fixed axis, as would normally be the case; and the focal spot will naturally follow this motion, striking a different point on the target. When this point is burned through, the cathode can be turned again and yet again, until all the space on the target is used up in actual operation.



The apparatus for shifting the X-ray focal spot. For explanation of reference numbers see text

The cathode fits over and revolves on a stem (marked 1 in the drawing). When the tube is in use the cathode must be rigidly stationary; so it is locked in place on this stem. In order to unlock it preliminary to turning, the same magnets are brought into play. When the magnet is placed around the neck of the tube just outside the cathode, its attraction draws the two steel blocks (2 in the drawing) in a direction parallel with the stem. This releases the clamps (3), and leaves the cathode free to revolve on the stem under the force of the magnet.

Another interesting X-ray development by the same inventor is a movable anode for general spectrum analysis. This makes it possible to imbed different metals in the anode, and by shifting the latter any one of these can in its turn be brought in focus with the cathode stream. So it is possible to use a dozen metals in the one tube, a thing which formerly would not have been feasible—as many tubes would have had to be used as metals, one tube for each metal. The movable anode has a weight extending from it, and by revolving the tube in the hands, the operator can make the anode turn until the desired metal is brought into focus. A small roller mounted on the anode helps to give motion to this part, and at the same time makes it possible to install a scale showing just which metal is in focus at every moment.

Automatic Signaling on the Highway

THE danger signal herewith illustrated is now in operation in California, and has been so efficient in eliminating the hazard at a certain sharp, blind curve that a petition has been circulated in the community concerned, favoring the installation of the device at other dangerous turns and blind crossings.

At the particular turn where the signal has been tried, the road is so narrow that it is absolutely necessary that cars should not meet; if they do, there will either be a collision or a backing out by one of them to the neck of the bottle. Moreover, the curve is sharp and blind.

The apparatus which has been put in to meet this condition consists of a trigger trap in a box 12 inches wide and any desired length. This is buried level with the surface of the highway, with the trigger projecting about two inches above the trap. When this trigger is run over by an automobile, the wheel presses it downward and in this way pulls a wire which runs underground to a signal post. This wire is connected with a ratchet which revolves the arm on the signal post, warning any autoist who may be coming in the opposite direction to wait for the first car to pass him before he ventures on the dangerous stretch.

Of course it would be out of the question to employ here a signal that had to be reset. The car which set it might fail to run over a resetting trigger; and the car coming the other way could not be left to reset it, because there is not always such a car. So advantage is taken of the fact that while highly dangerous, the narrow piece of road is fairly short. The danger indication consists merely in motion of the signal arm, not in any particular position thereof; and a car which is not near enough to the signal post to enable its driver to see such motion will not reach the curve until the signaling car has passed off of it.

Highway block signal and the trap at the end of the dangerous stretch which operates it

Applying a magnet outside the cathode tube to shift the focal spot

Army Camp Laundries

Laundries are to be provided in all the principal camps and cantonments. The average cost of each will be $150,000. The expenditure of $5,754,990 for this purpose has been authorized. The work will be done by the construction division. Power to operate the laundries will be supplied by special power houses, which will be erected at the same time. The buildings in each of the larger camps will cost $176,000, while $130,688 is provided for each of the smaller camps.

I Am Public Opinion!

ALL men fear me! I declare that Uncle Sam shall not go to his knees to beg you to buy his bonds. That is no position for a fighting man. But if you have the money to buy and do not buy, I will make this No Man's Land for you!

I will judge you not by an allegiance expressed in mere words.

I will judge you not by your mad cheers as our boys march away to whatever fate may have in store for them.

I will judge you not by the warmth of the tears you shed over the lists of the dead and the injured that come to us from time to time.

I will judge you not by your uncovered head and solemn mien as our maimed in battle return to our shores for loving care.

But, as wise as I am just, I will judge you by the material aid you give to the fighting men who are facing death that you may live and move and have your being in a world made safe.

I warn you—don't talk patriotism over here unless your money is talking victory Over There.

I am public opinion! As I judge, all men stand or fall!

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One day we hauled 672 cases of canned goods, weighing 70 lbs. per case from our factory to Woodside, Del., a distance of about 4 miles. We consider this a remarkable feat. We did not drive above 10 miles per hour, though we could have easily made 15 miles.

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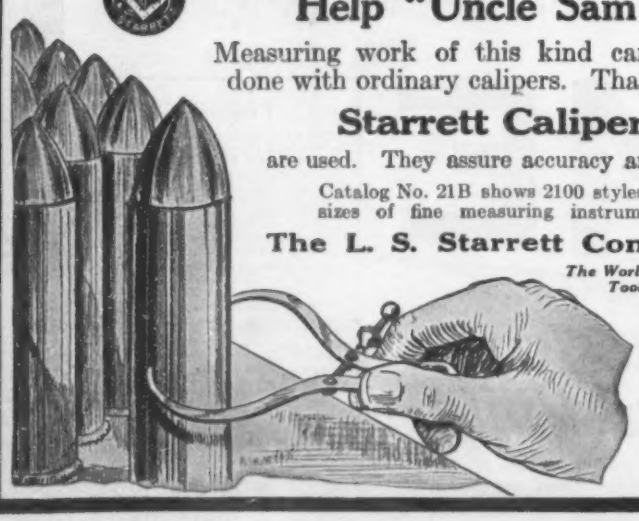


42-542

World Markets for American Manufactures

Conducted by WILLIAM W. SNIFFIN

A department devoted to the extension of American trade in foreign lands

How Ships and Banks Will Help Us

THE beginning of our export trade was very much like the experience of the little boy learning to swim. At first he dipped his toes in the water and slowly waded in up to his knees. Then a lot of other boys playing in the same pool drew him toward the deeper part and finally he was in over his head and had to strike out whether he wanted to or not. The United States was handicapped in foreign markets before the war because it lacked a deep-sea merchant marine and adequate banking facilities abroad. American machinery sold in Hongkong was carried in ships flying the British, German or some other foreign flag and paid for through banks controlled by foreign capital. It was not so great an obstacle to depend upon our competitor's ships as it was to rely upon them for handling the financial end, which enabled them to learn all the details and to share the knowledge with manufacturers of their own nationality.

Our New Merchant Fleet

One of the most memorable dates in American history is July 4th, 1918. It is probably the most important, so far as foreign trade is concerned. On that day American shipyards hung up a new world's record for launchings, one hundred-odd vessels gliding down the ways. With these ships and many others built to meet the present emergency we shall win both the war and the commercial struggle to follow. The new American merchant marine will carry American goods under the American flag to every nook and cranny of the seven seas. Nearly three million deadweight tons is the capacity of the 535 vessels launched up to the end of August. More than three hundred of these are now in service.

It is freight rates and tariff duties that send up the cost of imported articles, and freight rates are governed by the number of ships available. In normal times only the line vessels are operated on regular schedules. From a visit to any large port it is immediately evident that the liners are greatly outnumbered by the tramp steamers, which wander along the ocean lanes in constant quest of a handout of cargo. They haven't any excuse for not working these days, when everything that floats, from a flat-bottomed scow to the newest leviathan, is at a premium; but in the critical period to come there is going to be a sharp readjustment in their voyages and values.

A Speedier Delivery System

The war has done more than the opening of the Panama Canal or any other agency to shorten the world's trade routes. A great many of our imports from South America came by way of Europe, as did our purchases of colonial products shipped thousands of miles to Liverpool, Havre, Rotterdam and other great ports and transshipped across the Atlantic. This required large fleets and the goods were long in transit. To save ships and to save time the United States Shipping Board is now operating the fifteen hundred vessels under its control on schedules as careful and exact as those of railroad trains. A ship leaves and enters an American port every six minutes, including coastwise traffic. There is a departure from a North Atlantic port every 11 minutes and one for Europe every 40 minutes. Vessels in the service of the Army and the Navy are not included. The Shipping Board keeps close tab on 3,000 other ships that bring commodities to the United States and 2,500 more scattered over the globe trading with the Allies and their colonies. Thus the movements of about one-fourth of all the merchant ships in the world are followed closely and the tonnage necessary to transport the products of each country is approximately known.

This study will yield valuable results later on. We can send our goods in our own ships and attain higher efficiency in both trade and transportation. The need of this is apparent from a casual review of the intensive plans being made by all the leading nations, in whose preparations ships occupy a prominent place. Great Britain, working its shipyards to the limit of their capacity; Germany, which is reported to have added more than a million tons to its merchant marine during the war; and Japan, the great cargo carrier of the Pacific, will be well represented on the ocean highways. We must find markets for our surplus manufactures and employment for our new ships. How are we going to finance this large volume of trade?

How Our Banks Are Reaching Out

Within the past few years some forty branches of American banks have been established abroad and a number of financial organizations have been formed in this country to specialize in foreign business. The Federal Reserve Board is assisting in this work just as the Shipping Board is lining up our ocean transportation system. It is very desirable to have American banks in the strategic trade centers of the world. Not many years ago an American manufacturer received a large order from a merchant in a Brazilian city. Unable to obtain information about his prospective customer's business standing from any of the mercantile agencies, the manufacturer wrote to three banks in Brazil. Only one replied and it didn't give him the data that he wanted, but because the report was not unfavorable he trusted to luck and shipped the goods with a draft payable 90 days after sight. A year later he had managed to collect about half the money due him. An American bank would have supplied sufficient credit information to enable the manufacturer to avoid such an experience.

Our exporters have been saved a lot of trouble through the American banking facilities now available in Venezuela, where the customs laws permit the consignee to obtain his goods without surrendering the bill of lading. If the shipper consigns his merchandise to one of the American banks in that country, the goods are protected until this document is turned over. In that country, as well as in many others, the customs regulations include heavy penalties unless apparently unnecessary details are noted in the bill of lading and other papers. For instance, the name of the captain of the ship transporting the goods must be shown. The American banks look out for these little things and make sure that the documents are in order.

Finding Work for American Capital

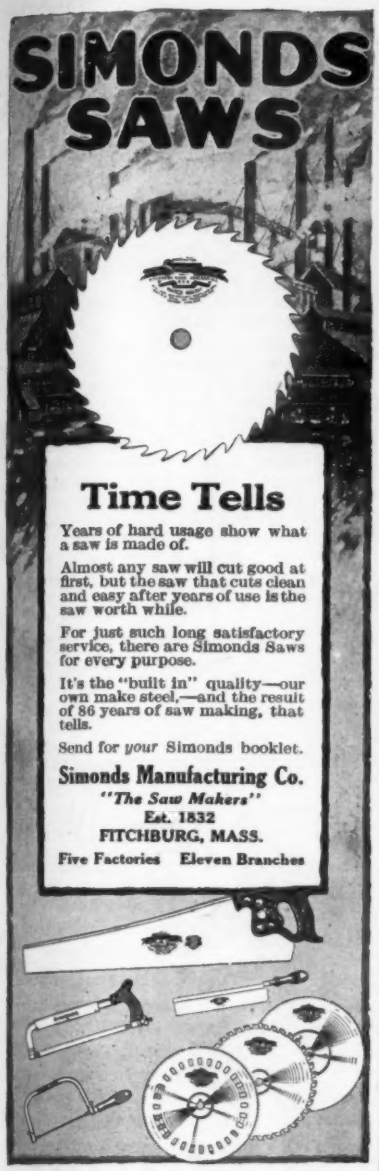
Investments are a logical forerunner of trade. One of the most pressing needs of American banks abroad is to investigate opportunities for the profitable use of American capital in developing, rather than exploiting, natural resources. Although the United States is less dependent than most nations upon imported raw materials and foods, they are essential to our industries and their aggregate value, $1,500,000,000 in 1917, will grow in succeeding years. The mountains of Colombia are now the principal source of supply of platinum, the Russian deposits having become temporarily inaccessible. Last year Colombia produced 25,000 ounces of this valuable metal, all of which came to the United States to be refined. Whether we shall continue to receive it after the war depends upon the extent to which American capital may succeed in improving the crude process of mining and upon the facilities available for financing the output. China is a fertile field for American investments and Russia presents large opportunities that will undoubtedly be grasped when conditions become favorable. Our future trade with these countries will be measured directly by our participation in their economic development. Branches will be opened in China, Manchuria, and Siberia by an American banking corporation formed recently, and these financial outposts should aid materially in expanding our oriental commerce.

Keeping the Dollar at Par

By far the most important function of American banks in foreign countries is to maintain the parity of the American dollar throughout the world. The war has made the United States a creditor nation, with a favorable trade balance of more than $3,000,000,000 in 1917, yet the American dollar is at a discount in the neutral countries of Europe and in South America. England seems to have guarded its exchange position better than any other nation, the pound sterling having been kept close to the normal rate largely through the aid of a score of foreign banks with more than two hundred branches. How an American bank abroad may influence the exchange rate was explained the other day by an officer of an institution that has a branch in one of the cities along the northern cost of South America.

"As long as a bank's depositors think there is plenty of currency in its vaults there is no danger of a run on it. The same principle applies to foreign exchange. Ever since our foreign house was established it has kept on hand a certain stock of gold, which has had the psychological effect of inspiring confidence in the American dollar and maintaining its parity."

By facilitating loans, investments, sales, and services abroad American banks can stimulate the flow of exchange, at the same time controlling it so as to conserve our credit-giving power, based upon the greatest reserve of gold ever known. The time is at hand when American manufacturers,



Time Tells

Years of hard usage show what a saw is made of.

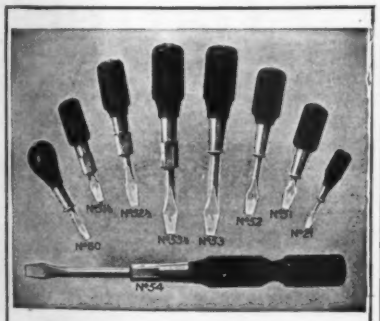
Almost any saw will cut good at first, but the saw that cuts clean and easy after years of use is the saw worth while.

For just such long satisfactory service, there are Simonds Saws for every purpose.

It's the "built in" quality—our own make steel,—and the result of 86 years of saw making, that tells.

Send for *your* Simonds booklet.

Simonds Manufacturing Co.
"The Saw Makers"
Est. 1832
FITCHBURG, MASS.
Five Factories Eleven Branches



"Hurwood" Screw Drivers

Unsurpassed for Strength and Durability

Blade, Shank and Head—one piece of special steel, finely tempered. The Blade cannot turn in the Handle.

The Assortment illustrated above is well worth your attention.

For instance—No. 21 shown at the extreme right of the picture—blade only 1½ inches long, just fits the vest pocket, a strong little Driver and very handy.

Also No. 60—shown at the left—only 1⅛ inch blade but with a big sure grip handle. For heavy work into close corners it cannot be beaten. Used by Plumbers, Machinists, Millwrights, etc.

Nos. 51, 52 and 53—Called MACHINISTS' DRIVERS—big, broad tips for large screws and extra large shanks for heavy work.

Nos. 51½, 52½ and 53½—also Machinists' Drivers, have hexagon nut on shank for use with a wrench.

No. 54—Note the DOUBLE GRIP, also the hexagon feature for wrench. With this latter Driver one can turn anything.

We make many other drivers. See Catalog No. 34.

STANLEY RULE & LEVEL CO.
NEW BRITAIN, CONN. U.S.A.

the superior quality of whose products has always been conceded, will have the shipping and the banking advantages previously lacking, and these will accelerate their drive for a good share of the world's trade.

Restoring French Factories

BEFORE the war northern and eastern France, with Belgium, constituted one of the world's busiest workshops. Nearly one-third of the entire industrial output of France was represented by the invaded districts, with their 25,000 or more factories and other establishments, most of which have been totally wiped out by the German vandals. Coal mines have been flooded, electric power stations dismantled, and textile mills pillaged. This industrial ruin, complete in the territory regained by the Allies and certain to be wrought in the sections still to be evacuated by the enemy, presents tragic evidence of German ruthlessness. But the French mine owner, central station man, and manufacturer won't stay down. The spirit of the new France is strong. The destroyed industries will be restored as soon as possible after the war is won.

How will the materials be procured for this gigantic work of reconstruction? Is a man who formerly manufactured woolen textiles in Rheims and whose establishment is a mass of shattered debris to purchase in the open market the machinery to enable him to resume operations, bidding against thousands of others? It is obvious that if such were the case confusion and delay would result. The task is too great to be undertaken by individuals acting independently.

Collective Buying Decided Upon

In December, 1914, when the war had been in progress only a few months, the French Government began to consider the problem of restoration and decided that the aid and the direction of the State would be necessary. One year later an association of more than one thousand manufacturers was formed, the membership being divided into four groups—textile industries; mining, metallurgy, heavy machinery and electrical construction; agricultural industries; and miscellaneous industries. After this organization has studied the ways and means of reconstruction, a purchasing bureau controlled by its members will buy the needed materials out of a fund provided by the Government. Here is an ingenious plan that will make every cent count.

When this well-knit association is ready to purchase billions of dollars' worth of construction materials, such as iron and steel, lumber, brick, sand, cement, copper and zinc, for rebuilding the destroyed plants and of special equipment—textile machinery, electrical generators, boilers, engines and so on—for getting them under way it doesn't want to go shopping all over the world for them. Of course, everything needed can't be obtained in one place, but the French idea is to deal with as few selling organizations as possible. To obtain prices from hundreds of firms engaged in supplying thousands of articles would involve long delay.

The Need of Collective Selling

France looks to the United States to furnish most of the commodities required for restoring its industries. If American manufacturers are to respond to this call with the same spirit of service manifested toward their own government during the war, as they undoubtedly will, they must recognize the fact that only the attainment of the highest efficiency in production and in selling will meet the French demand. They must get together on this side just as their prospective customers have joined hands on the other side, not because it is a matter of competition with the manufacturers of other nations but because the expeditious handling of the business means concentrated selling. The smaller American manufacturer need not worry about being frozen out. There will be orders enough for all. But here is the point: Jones & Smith, who make machine tools in their small but well-equipped plant in the Middle West, want a share of the French trade. Suppose that they sent their catalog and price list to the purchasing bureau in France, and that comparison had to be made with thousands of other American catalogs and price lists, and that each firm had to be investigated before any orders were placed with it. Obviously such a method is out of the question when purchases are to be made on such a large scale.

What is needed is a counterpart to the French organization in the form of collective selling. Just as the buyers have united, first in small groups, then in a large association, so should the suppliers combine forces, leaving the actual negotiations to strong and responsible firms able to handle a big job in a big way. This coming opportunity to aid in restoring one of the world's greatest industrial regions must be seized by American manufacturers animated by the motive of "all together for France!"

THE LESSON OF 1918-

UNDER the radically altered conditions which confront us in this greatest crisis in our national history, the need for superior truck equipment is obvious.

Solid truck tires that were ample in peace times—ample in cushion when hauling was confined to congested districts and smooth pavements—have demonstrated that they *will not do* today over rough inter-city roads.

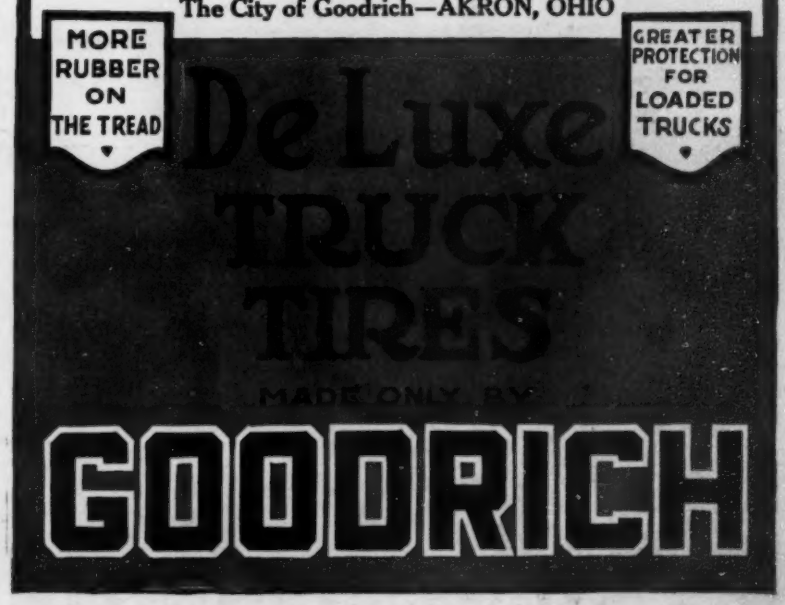
The great lesson of 1918 is that trucks MUST have *more cushion*—MORE RUBBER ON THE TREAD!

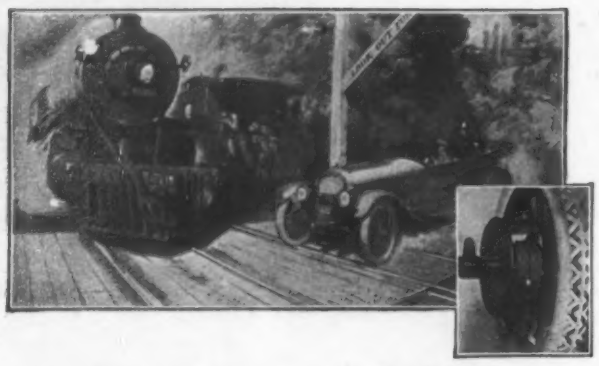
Fortunately for many truck owners, Goodrich science had forseen the inevitable need which would spring from increased use of trucks. The same genius that produced Goodrich Silvertown Cord Tires constructed a truck tire with *more rubber* on TOP of the tread where the wear comes.

In this past year of unprecedented demands on motor trucks, Goodrich judgment and foresight have been sustained. Goodrich De Luxe Truck Tires have not only run farther, but the extra rubber on the tread has cushioned the load and the trucks. Owners found that Goodrich De Luxe Tires were *thrifty* tires because of their scientific construction.

Goodrich De Luxe can be had in all popular sizes at all Goodrich Branches and Goodrich Distributor Service Stations

THE B.F.GOODRICH RUBBER COMPANY
The City of Goodrich—AKRON, OHIO





The worst season of the year for automobile accidents

SEPTEMBER and October are the worst months of the year for automobile accidents. Here is the reason:

All summer long you have been running your car. Naturally the brakes are worn. Then there comes an emergency when you must stop quickly—*but you find you can't!*

That is what is happening to so many motorists this month. That is what may happen to you. There are more accidents in the fall than at any other time of the year simply because brakes have been made dangerous by a season's wear.

Make certain today that your brakes are safe

You will be running your car for two or three months longer; perhaps all winter. You can't afford to let your safety, and the safety of your car, depend on brakes that are worn. Have your dealer inspect your brakes today. If they need relining have him put on Thermoid Hydraulic Compressed Brake Lining.

Gives greatest security for three reasons

1st—Contains over 40% more material and 60% more labor than ordinary woven brake lining. This gives longer wear.

2nd—It is Grapnalized, a special exclusive process which enables Thermoid to resist moisture, oil and gasoline.

3rd—Thermoid is Hydraulic Compressed. It wears down slowly and can be used until cardboard thin.

Support the Brake Inspection Movement and have your brakes inspected today.

Our Guarantee: Thermoid will make good or WE WILL.

Thermoid Rubber Company

Factory and Main Offices

Trenton, N. J.

At speed of	A car should stop in
10 miles per hr.	9.2 ft.
15 " " "	20.8 "
20 " " "	37 "
25 " " "	58 "
30 " " "	83.5 "
35 " " "	104 "
40 " " "	148 "
50 " " "	231 "

Thermoid HYDRAULIC COMPRESSED

GRAPNALIZED FRONT GRAB OR SLIP

Makers of "Thermoid Crolide Compound Casings" and "Thermoid-Hardy Universal Joints"

Will your car do this?

of course!

"Nobody ever changes from Rameses"

the aristocrat of cigarettes

ECONOMY renewable FUSES

Replace the Link—Renew the Fuse

cut annual fuse maintenance costs 80%. Can be used over and over. An inexpensive "Drop Out" Renewal Link restores a blown Economy Fuse to its original efficiency.

ECONOMY FUSE & MFG. CO.
Kinzie & Orleans Sts., CHICAGO, U.S.A.
Sole Manufacturers of "ARKLESS" the Non-Renewable Fuse with the 100% Guaranteed Indicator. Also made in Canada at Montreal

RAISE BELGIAN HARES For U.S.

HUGE PROFITS easily and pleasantly made. We furnish stock and pay you $6.00 a pair and express charges for all you raise. Contract and book "Fortunes in Hares," 10c. Nothing free.

NATIONAL FOOD & FUR ASSOCIATION
Dept. 229 MILWAUKEE, WISC

THE Economy of the New Stromberg Carburetor is not a "hair breadth" matter. It represents a saving of real importance—to the purse of the motorist and to successful conduct of war activities that call for strict conservation.
For particulars send name, model and year of your car
Stromberg Motor Devices Co. 64 E. 25th St., Chicago
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UNUSUAL ECONOMY
THE KIND THE U.S. NEEDS
New STROMBERG Does it!
CARBURETOR

Methods That Win

"THIS firm could have made more than $100,000 during the last three months if we had chosen to sell our dyestuffs with regard to present conditions and without considering future business," declared the president of one of the newer dye manufacturing concerns recently. "Our representative in the Far East, whose instructions are to appoint the best agents that he can find to handle American dyes after the war, reports a heavy demand for our products and says he's sorry that we won't let him canvass the field for orders at the present time. We want to get into the export trade in the most sensible way and the plans now being carried out should enable us to meet the strenuous German competition that is coming.

"One of the largest exporters of dyes in this country is sending his products to India in barrels. When they arrive, the native dealers retail them in tins made of old oil cans or whatever material may be available and stamp them with their own names. The ultimate consumer has no way of knowing that the colors originated in the United States. That's not our method. We are not shipping any dyes in bulk, in spite of the scarcity of tinplate, which makes cans difficult to obtain. The other day we sent 10,000 one-pound tins to China and each bore our name, plainly stamped.

"A story I heard the other day illustrates the necessity of studying and understanding the shades and color effects desired by foreign purchasers. The dye industry in the Straits Settlements is mainly in the hands of the Chinese, among whom a certain black effect is very popular. Formerly the local dyers secured this color by dipping the cloth 15 times in a cold indigo solution, drying it in the sun between times. This laborious and expensive process aroused the interest of the representative of a European manufacturer, whose study of that particular color resulted in the production by his concern of a dye that would bring the proper shade with one dipping. Letters and samples would never have created the demand that was established in this way."

Encouraging the Foreign Agent

How an American manufacturer of cotton goods obtained a generous share of the trade in a Latin American country was described in a recent conversation. "At first we had an agent who sold our line on a commission basis," he explained. "This man handled a number of other articles and we were not at all satisfied with the volume of business that he sent to us. I went down there and had a plain talk with him. 'What we want is the large-quantity trade,' I told him. 'We don't care about an order for $100 worth of goods from Sanchez or $200 worth from De Soto. We are going to treat you just as though you were one of our representatives in Chicago, New Orleans, or some other city in the United States, quoting you prices by cable, and it will be up to you to land the big orders. We want you to feel that you are in just as close touch with us as are any of our men in the United States.' Not long after that, things began to pick up, and eventually our sales of cotton prints in that country aggregated $750,000 a year."

Agents of the Bureau of Foreign and Domestic Commerce have collected thousands of samples of goods sold in foreign countries. American manufacturers who have examined these and reproduced them have been very successful in disposing of their new products abroad. India, for example, is one of the world's greatest consumers of cotton goods. The United States has never had its proportional share of this trade because our mills can not turn out some of the particular varieties for which the Indian merchant calls, unless new processes of manufacture are employed. The larger American firms, however, are now devoting close attention to the samples gathered by the Government agents, and several will produce the goods desired.

A short time ago an American consulting engineer returned from a trip to Australia and New Zealand with the information that most of the electric lamps used in those countries had a bayonet base. The type was not manufactured in the United States, where the screw base is generally employed. By installing special machinery a large electrical goods plant in New England was able to produce a greatly superior article, which will have a ready sale in the Australasian market. It was by making anything and everything that a foreign customer requested that Germany made headway in so many trade fields. We are doing better, by reproducing the goods desired and at the same time adding to their quality.

American Banks Abroad

Exporters who wish to establish foreign banking connections and are in doubt where to turn, to do this may consult with profit a list of the foreign branches of American banks, and the banks authorized to take stock in the American Foreign Banking Corporation, which appeared in No. 194 of the U. S. Commerce Reports.

Is It Not Sound Policy

for you to do your banking business with a Trust Company?

Such a company not only can look after your money while you are alive but, if you wish, can act as Executor, Administrator, Guardian, Receiver or Trustee. It is a Legal Depository for funds of every description.

This Company especially attends to the management of Personal Property and Real Estate and to the collection and remittance of rents, interests and dividends.

Our officers will be glad to confer or send you information concerning any of our banking or trust services.

Write for our booklet "Management of Your Estate"

Central Union Trust Company
OF NEW YORK

80 Broadway—54 Wall Street

BRANCHES
Fifth Ave. at 60th St. Madison Ave. at 42d St.
Fifth Ave. at 38th St.

Capital, Surplus and Undivided Profits $29,000,000

An Actual Incident in a Los Angeles Hotel

"I Should Worry about Pockets—"

said a sailor boy.

"MY Boston Garters have never failed me yet."

He thus expressed the confidence that every wearer has in the security of the

Boston Garter

You can always rely on them to "stay put." And it's a real pleasure to wear them because they keep your socks smooth and rest so lightly on the leg that you forget you have them on.

At leading stores from coast to coast.
GEORGE FROST CO., MAKERS, BOSTON

Low Cost of Upkeep

ROTH MOTORS

Successful More Than 20 Years

are built for work, not for idleness in the repair shop. So they give steady, day-after-day service at a low cost of operation. Twenty years' success is their best recommendation. Write for full facts.

Roth Bros. & Co.
198 Loomis Street
Chicago, Ill.

DO YOU *develop and print your own PICTURES*?

Then use a new economical American developer (De Nova) not approached in chemical quality by any similar American product. *Better than Metol.*

No matter how many developers you have experimented with—try DE NOVA

FREE SAMPLES sent on receipt of self-addressed stamped envelope.

Special Offer to Dealers

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The House of Taylor

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B'WAY, 32d & 33d STS., NEW YORK
Direct Entrance to Broadway Subway and Hudson Tubes
One Block from Pennsylvania Station

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400 Baths 600 Rooms

Equally Convenient for Amusements, Shopping or Business.

Rates $2.00 Per Day and Up.

A SPECIALTY. 155 Pleasant Rooms, with Private Bath, $3.00 PER DAY.

The Martinique Restaurants Are Well Known for Good Food and Reasonable Prices.

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the world's standard!

Smooth, gritless, lasting, true to grade and perfect in detail, VENUS Pencils satisfy *every* requirement.

Use 6B-5B-4B-3B for bold heavy lines

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Use 3H-4H-5H-6H for clean, clear, fine lines

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FREE!

Write today for interesting instructive booklet "The VENUS Pencil in Mechanical Drafting." It will be sent on request.

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217 Fifth Ave. New York
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Showing Up the Machine

Perhaps your machine has an unworked capacity; perhaps there's need of mechanical improvement or repair; perhaps it's possible to speed up the operator—you'll *know* from a

Veeder
COUNTER

The Rotary Ratchet Counter shown at left counts reciprocating movements of the lever, corresponding with the operations of your machine. Most adaptable for small machinery and experimental work.

Price, $1.75

The exact counter you want for any type of machine will be found in the Veeder booklet; shall we send you a copy?

THE VEEDER MFG. CO.
18 Sargeant St., Hartford, Conn.

The Bessemer is a Successful Oil Engine

THE oil burning engine that transforms cheap crude oil into horse power is here to stay. It is no longer a curiosity or experiment. The war has settled that. And after the war, when efficiency and strict economy in production will be essential to success, you will find Bessemer Oil Engines in the forefront of the world's successful plants. Preparedness, in such a case, means the replacement of present equipment (as circumstances will permit) with Bessemer Oil Engines.

The Bessemer Gas Engine Co.
14 York Street Grove City, Pa.

BESSEMER
OIL ENGINES

Cooking Corn Cobs

(Continued from page 273)

last moment when filtering is possible, in other words. Here the candy maker will recognize a trick taken from his trade; that of waiting, and waiting, and waiting, until what we are waiting for can't be delayed another second—and then of pouring right away, in a hurry.

The upshot of all this fussing is a light yellow or nearly colorless product, which bulks exactly half of the cellulose with which we started, while the other half of that cellulose is accounted for by the undissolved solids filtered off in the beginning. It is then possible to take these solids, and, by treating them in exactly the same way as the liquid from which they were drawn, convert half of them into glucose, which is added to that already obtained to give a total yield amounting to 37½ per cent of the original cob weight. The second residue, it would seem, might be run through again, and again, and again, giving an infinite geometric series of glucose recoveries; but as a matter of fact, we get about all the glucose that is coming to us in the treatment of the first residue, and there is not enough to be had from the remaining solids to pay us for looking for it.

If the glucose product were to be used for human food, it would be necessary to employ the very purest lime in its preparation. Produced without special precautions, the samples which have been exhibited have had a slight metallic taste when put in the mouth in any quantity. This is apparently due to the presence of small quantities of magnesium in the commercial lime used in their manufacture. For use as stock food, little or no purification would be required; and if it were to be employed for alcohol manufacture, it would not even be necessary to evaporate it; what we have apologized for calling a neutral solution would serve perfectly well.

At present there are not sufficient data to estimate accurately the cost of preparing glucose by the method described. It would depend largely on the cost of the sulfuric acid and the lime used. The former is the determining factor, since a good deal of very strong acid is called for. At the prices of today, it would seem as though glucose could be made in this way for about the same cost as from starch. It is to be assumed that after the war, however, there will be a considerable drop in the price of sulfuric acid owing to its lessened consumption in the manufacture of explosives and to the restoration of pyrites importation from Spain. The process could then be worked to great advantage.

On the whole, the prospects held out by Mr. La Forge's suggestion are entrancing. If we will but imagine all our available corn cobs worked up into the products mentioned, we will find ourselves with enough glucose from this source alone to fatten all the cattle we could raise, or to make all the alcohol we could use. We would have xylose baking powder sufficient for all the biscuits that were ever baked; and there would be no such shortage of acetic acid as holds today. But we need not dwell upon such fanciful prospects as these. Our great supply of now useless corn cobs should be regarded rather as an almost inexhaustible source of material to maintain an industry producing the products which have been mentioned.

New Apparatus For Washing Coal

AN English authority gives some particulars of the "rheolaveur" apparatus for washing small coal, based upon an article contributed to the *Bulletin de la Societe de l'Industrie Minerale,"* by M. E. Dinoire, chief engineer of the Lens Collieries in France.

A trough is used from 12 to 20 inches wide and from 30 to 50 feet long, according to the quantity of coal to be treated. Its slope is from 1 to 1¾ inches per yard. At intervals of about eight feet apart it is provided with narrow open slits across its bottom, at right angles to its length. A current of water, of regulated velocity, rises up through each slit and joins a current flowing across the slit and along the trough. The velocity of the rising water through the slits is sufficiently great to prevent particles of coal under a certain size, but not particles of refuse of the same size, from sinking down through them. The coal to be washed falls from the shute of a sizing-screen into a stream of water at the upper end of the trough. The washed coal is delivered at the lower end of the trough; the refuse is ejected continuously in a stream of water through openings in the bottom of hollow cast-iron chambers called "rheolaveurs," into whose interior it falls after having passed through the slits. Each rheolaveur consists of a cast-iron chamber of inverted pyramidal form, whose base is uppermost and constitutes part of the bottom of the trough, and whose apex at the bottom has an opening through which the refuse is ejected. The chamber is divided into two compartments by a partition extending for some way down from its base. The slit in the trough is in one of these compartments, while the other receives a supply of water through a pipe under a pressure equal to a head of about

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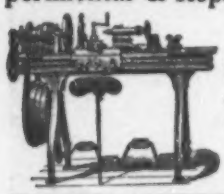

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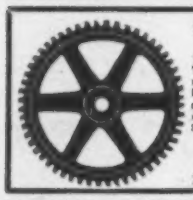

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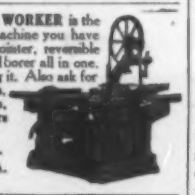

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twenty feet. When the stopcock on the supply pipe is open, one current of water ascends toward and passes through the slit in the bottom of the trough, while another descends toward and passes through an outlet at the bottom of the chamber. The inflow of water is regulated by the stopcock, and the ejection of the refuse by a valve at the bottom of the chamber having several openings of different diameters, any one of which can be substituted for another as required. The quantity of water required is less than one-half of that required for washing-boxes. The arrangement comprises as many rheolaveurs as the trough has slits in its bottom.

Trials were made to ascertain the comparative results of washing coal with felspar boxes and with rheolaveurs. The operations were carried out in such a manner as to insure that the quantity of ash washed out was the same in every case. The percentage of refuse up to ⅜ inch in diameter was 8.728 per cent of the fine coal treated with the rheolaveur, as against 1.027 per cent with the washing box; that is an advantage of 1.3 tons per 100 tons of coal treated. The content in ash of the total refuse washed out by the rheolaveur was 65.01 per cent. In working the rheolaveurs continuously for six months, and treating 2,000 tons per 24 hours, it was found that, as compared with washing-boxes, a saving of 20 tons of coal per day of the size up to ⅜ inch in diameter was effected. During this period the capacity of the washer was increased to 115 tons per hour. The special trials with coal up to ⅜ inch in diameter having been completed, the Lens Company installed the same mode of washing for coal from ⅜ to ¾ inch diameter with equally satisfactory results. They now propose to enlarge the installation so as to wash also the size ¾ to 1 inch in the same way.

Rheolaveurs have recently been constructed, and are now at work at the L'Esperance and Bonne-Fortune colliers in Belgium, for sizes over one inch. This apparatus is of slightly different type from those described above. The makers, having found that they were obliged to make the outlets for refuse so large that the requisite quantity of water was not only very great, but also difficult to regulate, solved the problem by constructing an apparatus in which the refuse instead of being evacuated in a stream of running water, dropped into still water in a trough in which a screw conveyor carried it to the boot of a small elevator in the same way as is done in the felspar boxes for washing coal up to ⅜ inch in diameter.

Trench Fever Traced to Vermin

A DISCOVERY of incalculable value to the Allied armies fighting in Europe has just been made by the American Red Cross Research Committee. This is the scientific determination, after exhaustive experiment upon living subjects, that trench fever, the scourge of the battle line and responsible for a great loss in men at the front, is transmitted by body vermin. This discovery has been made through the courageous agency of more than sixty men of the medical and sanitary service of the American Army, who volunteered to subject themselves to the disease for the benefit of their comrades in arms. For the last three years trench fever has sent thousands of men to the hospitals and taken them from active service for months at a time. In the present researches, efforts were concentrated upon finding the method by which the disease is transmitted and it was believed that a means of preventing it would be then indicated. The question of the cause of the disease, or the living organism which produces the infection, could be taken up later. After many experiments it was evident that no animal could be infected with the disease, and for this reason it became necessary to experiment upon men. The call for volunteers brought forth nearly twice as many men as were needed, and 68 were selected, all Americans. Experiments began in one of the base hospitals. "One cannot speak too highly of these volunteers," said one of the members of the Research Committee; "they went through the unpleasant duty of being host to a number of vermin, and then had to wait with all patience for the attack of a disease known to cause great pain. However, these trials were borne without a murmur." All but one of the investigators who did the actual work were Americans, and the actual scientific work was performed by the Medical Corps of the United States Army.

It has now been demonstrated beyond doubt that trench fever is a specific clinical entity, differing from fevers hitherto known. It is shown to be transmitted by the bite of body vermin. The infecting agent is in the blood of the men having the disease, this infection being more virulent in the first 48 hours of the progress. The infecting agent is always retained in bacterial filters. It is always found in the plasma of the blood. Washed red corpuscles sometimes carry the agent down with them. The transmission of the disease has been proved not only by vermin from the trenches, but by vermin hatched from eggs brought from England, where trench fever does not exist. Vermin hatched from these eggs were permitted to bite men suffering from trench fever, and subsequently, by biting, these vermin carried the disease to uninfected persons.

New Detonators Made Without Fulminate of Mercury

PRACTICALLY all the detonators employed in the war have made use of fulminate of mercury, which the English munition maker, Joseph Egg, first used in 1816. In spite of its usefulness, this compound has serious disadvantages. Its preparation is both costly and delicate, so much so that numerous accidents occur during the process of drying, sifting and packing the charge. No method of overcoming this element of danger has been discovered, manufacturers confining themselves to arrangements which localize the explosion, and thus limit its dangers. Another fault is, that the prepared capsules containing fulminate of mercury do not keep well; their constitution alters under the influence of humidity, by reason of the fact that damp fulminate of mercury reacts on the copper or brass of the cap enclosing it to form a copper salt, which is extremely explosive; far more so, in fact, than the fulminate itself.

The problem of finding a satisfactory substitute seems to have been definitely solved by the *Deutsche Waffen und Munition Fabrik*, of Karlsruhe.

The detonator is composed of a cap made of brass or red copper, into which is forced under pressure a mixture of equal parts of chlorate of potassium and sulfide of antimony. Each cap receives about thirty millograms of this charge. The two chemicals in the mixture are both non-explosive, and can be handled with much less precaution than compounds having fulminate as a basis. Above this mixture with which the cap is charged, is placed a thin strip of tin; the lower face of this strip is varnished with gum lacquer, in which there have been dissolved finely ground red phosphorus, and a small amount of diphenylamine.

When the hammer strikes the bottom of the cap, the red phosphorus undergoes violent friction against the charge, and ignition takes place. The principle is practically the same as that of safety matches, which ignite when scratched upon their boxes. This new "safe" detonator is said to have all the qualities required, namely, the proper degree of sensitiveness, great ignition power and perfect keeping qualities.

Forestry Studies in Canada

OWING to the tremendous consumption of timber and pulp, the exhaustion of Canada's forest resources can no longer be regarded as an eventuality of the indefinitely remote future. Regulative measures are accordingly in order; but these must be based on scientific information, little of which has heretofore been available. In order, therefore, to obtain the scientific background for future remedial steps, as well as to curtail present wasteful practices, the Advisory Board of the Forestry Branch of the Dominion Department of the Interior recommended that a complete inventory be taken of the standing timber of eastern Canada, that a quick reconnaissance survey be made on the conditions of all cut-over lands, that a study be initiated of the possibilities and the successful methods of insuring reproduction of the more important timber trees, with special attention to white pine and spruce, and that an early determination be made of the volumetric rate of growth of the principal species, both when isolated and when in forest stands, in order that calculation against the future may be possible.

Some of this work has been attacked before, both in Canada and elsewhere. The Commission of Conservation has covered a good deal of the ground mentioned with reference to British Columbia and Nova Scotia. The study of reproduction rates of European trees has been undertaken, and a beginning has been made in the United States. In certain cases results obtained here would apply to Canada, but it must be remembered that the higher latitude renders climatic and soil conditions in Canada sufficiently different from those which prevail in her southern neighbor to make information on file in Washington at least uncertain in its application to Canadian problems.

In view of all this, when the matter was put before the Dominion Research Council, it was suggested that the investigations in question be made on the Petawawa Military Reserve. Of this reservation only 25 square miles is in actual military use, the remaining 80 square miles being available for other purposes, and constituting ample territory for much of the proposed work. The reservation is part of an old cut-over timber district, on which second forest has begun to develop, and the timber now present is at a stage of growth that renders it highly suitable for the project in hand. In 1917 the Research Council recommended that a grant be given to carry out the investigation.

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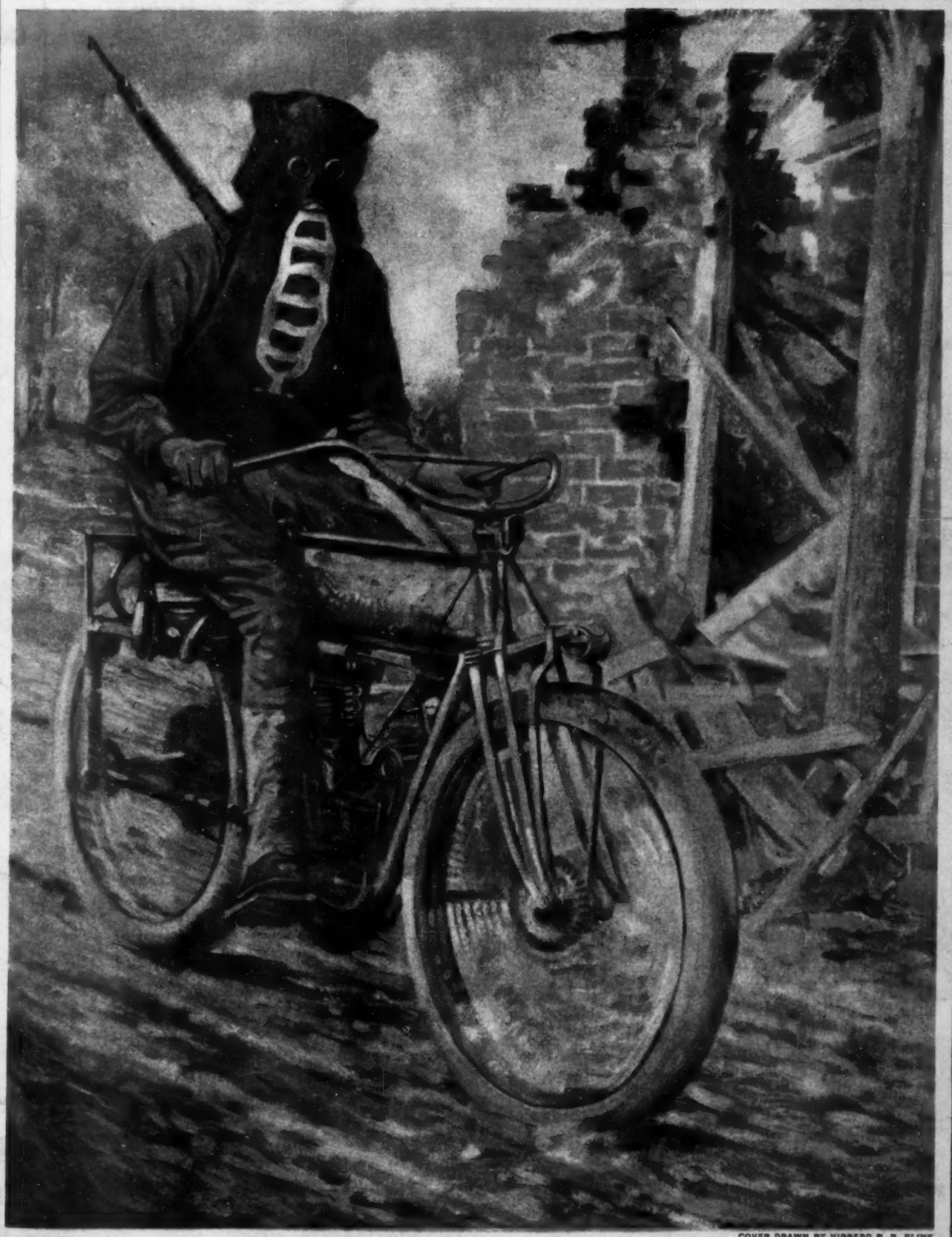

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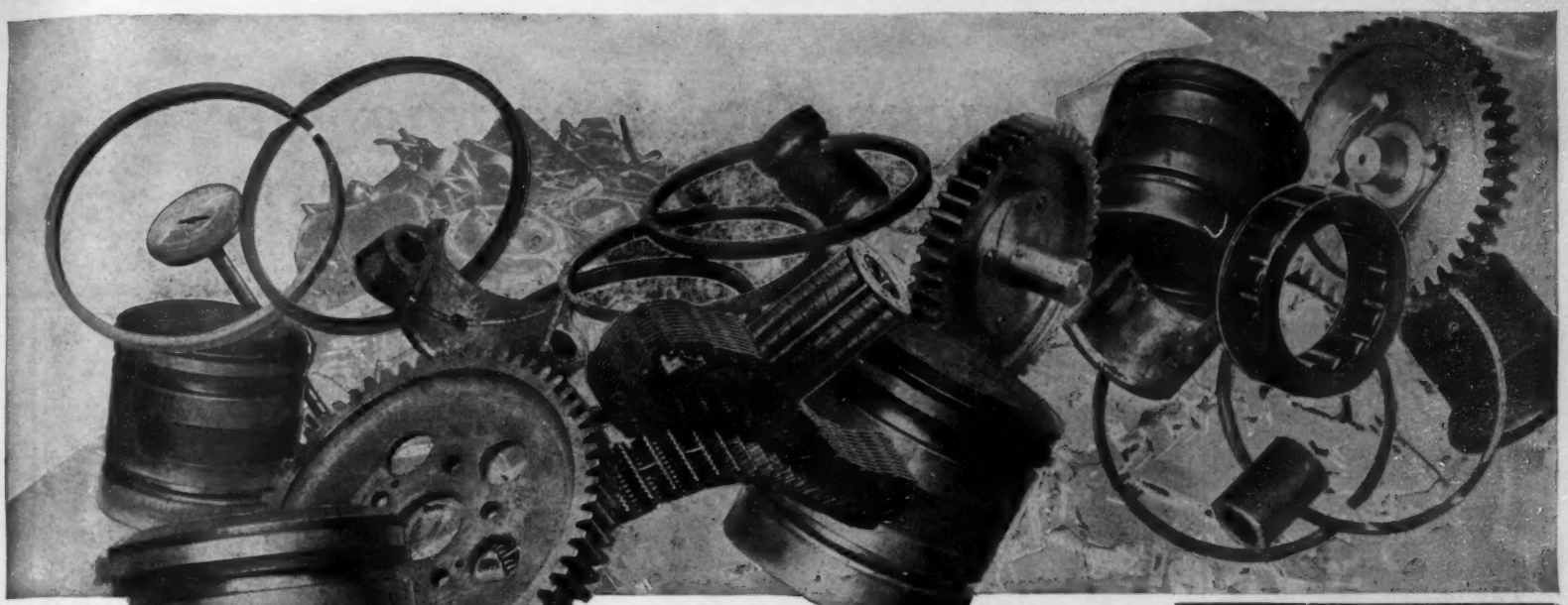

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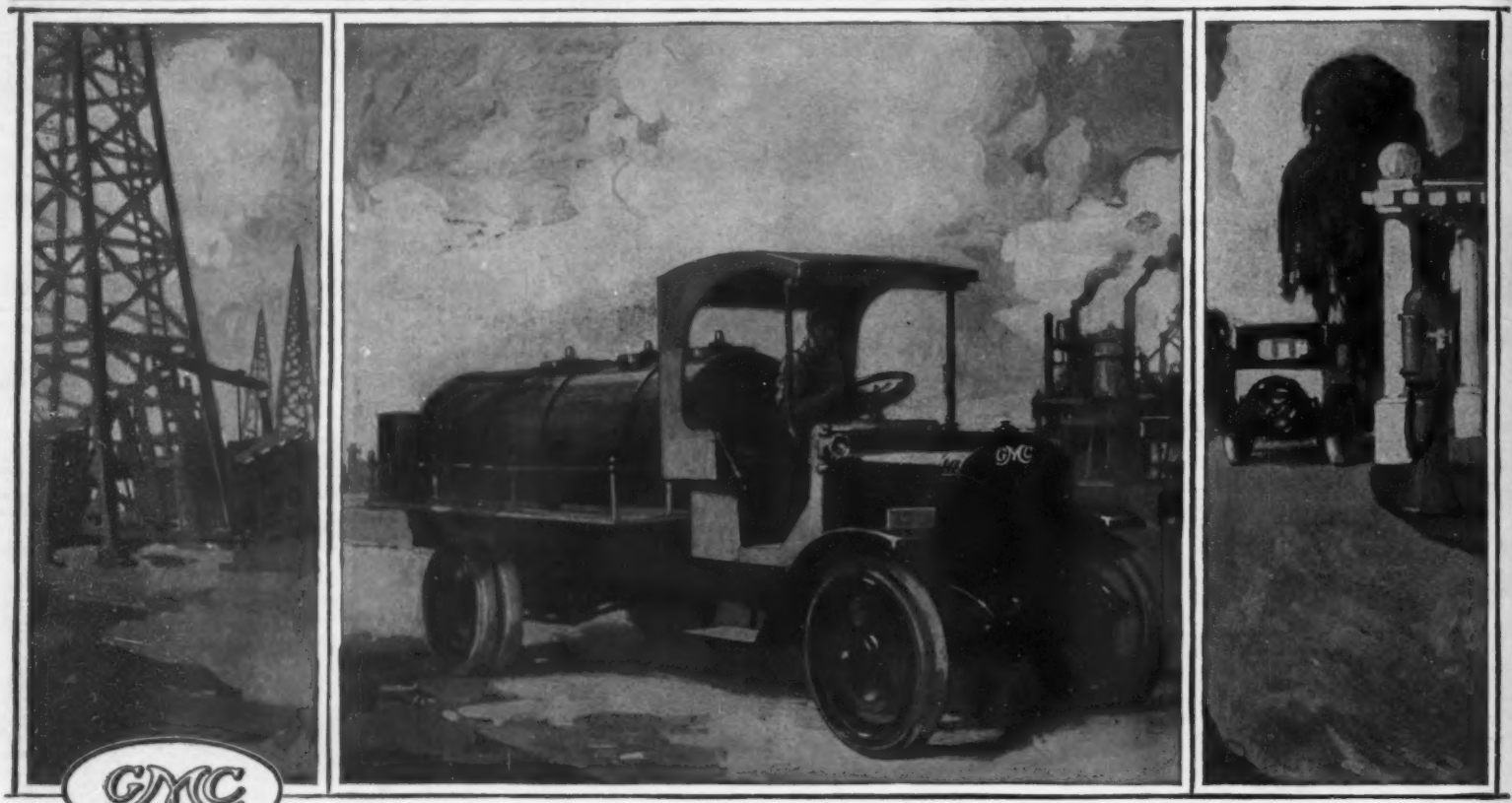
This Chart is compiled by the Vacuum Oil Company's Board of Engineers and represents our professional advice on Correct Automobile Lubrication.

AUTOMOBILES	1918 Models		1917 Models		1916 Models		1915 Models		1914 Models	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Abbott	Arc	Arc								
Abbott-Detroit			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)					A	A	A	A		
Allen	A	Arc	A	Arc	A	Arc	A	Arc	A	A
Apperson	A	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	A	A				
Auburn (4 cyl)					A	Arc	A	Arc	A	A
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (6-38 & 6-39)			A	Arc	A	Arc				
" (6-39)(Tractor H)	A	Arc								
" (6-39)(Conc'l)	Arc	Arc								
Autocar (2 cyl)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Briscoe	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl)					A	A				
Buick	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Cadillac	A	A	A	A	A	A	Arc	Arc	Arc	Arc
Case	Arc	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Chalmers	A	A			Arc	Arc	Arc	Arc	A	A
" (6-40)					A	Arc				
" (6-36)			A	A	A	A				
Chandler Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Chevrolet	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
" (8 cyl)	A	A	A	A						
" (F A)	A	Arc								
Cole										
" (8 cyl)	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
Cunningham					A	A	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	A	A				
Dart	A	Arc	A	Arc	A	Arc	Arc	Arc	A	A
" (Mod. C)			A	Arc	A	Arc	A	Arc	A	A
" (2 & 3½ ton)	A	A								
Detroiter	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	A
Dodge Brothers	A	Arc	A	Arc	A	Arc	E	E		
Dort	A	Arc	A	Arc	A	Arc	A	Arc		
Empire (4 cyl)	A	Arc	A	Arc	A	Arc	Ar	Arc	Arc	Arc
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc				
Federal	A	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Mod. S-X)	A	A	A	A						
" (Special)	Arc	Arc								
Flat	B	E	B	E	B	E	B	E	B	E
Ford	E	E	E	E	E	E	E	E	E	E
Franklin	A	A	A	A	A	A	A	A	A	A
Grant	A	Arc	A	Arc	A	Arc	Arc	Arc	Arc	Arc
Hal-Twelve			A	A	A	A				
Haynes	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (12 cyl)	A	A	A	A	A	A				
Hollier (8 cyl)	A	Arc	A	Arc						
" (8 cyl)	A	A	A	A	A	A	A	A		
Hudson					Arc	Arc	Arc	Arc	Arc	Arc
" (Super Six)	A	Arc	A	Arc	A	Arc			A	A
Hupmobile	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Jackson			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	A	A				
Jordan	Arc	Arc	Arc	Arc						
Kelly Springfield	A	A	A	A	A	A	A	A	A	A
King							A	Arc	A	A
" (8 cyl)	A	A	A	A	A	A	Arc	Arc		
" (Conv'l)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Kissel Kar	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" " (Mod. 48)					A	A	A	A	A	A
" " (12 cyl)	A	A	A	A						
Lexington	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Liberty (Detroit)	Arc	Arc	Arc	Arc						
Lippard Stewart	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Mod. M)			A	Arc	A	Arc				
" (Mod. MW)			A	Arc						
Locomobile	A	E	E	E	E	E	E	E	E	E
McFarlan	A	Arc	A	Arc	A	A	A	Arc	A	A
Madison	A	Arc	A	Arc	A	Arc	A	Arc		
" (8 cyl)			A	A	A	A				
Marmon	A	A	A	A	A	A	A	Arc	A	Arc
Maxwell	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Mercer	A	A	A	A	A	A	A	Arc	A	Arc
" (22-70)							A	Arc		
Mitchell	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl)					A	A				
Moline-Knight	B	A	A	A	A	A	A	A	A	A
National	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	A
" (12 cyl)	A	A	A	A	A	A				
Oakland	A	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A			A	A				
Oldsmobile	A	A			Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	A	A				
Overland	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Owen Magnetic	A	Arc	Arc	A	Arc	A	Arc			
" " (Mod. M2)	Arc	Arc	Arc	Arc						
Packard							A	Arc	A	Arc
" (12 cyl)	A	A	A	A	A	A				
" (Cam'l)	A	A	A	A	A	A	A	Arc	Arc	Arc
Paige (4 cyl)							A	Arc	A	A
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
" (6-36)					A	Arc	A	Arc		
" (6-36-39)			A	Arc						
" (6-40)	A	Arc								
Paterson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Pathfinder			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (12 cyl)			A	A	A	A				
Peerless	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	A	A				
Piercy Arrow	A	A	A	A	A	A	Arc	Arc	Arc	Arc
" " (Conv'l)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	A	A	A	A	A	Arc	Arc	Arc	Arc
Regal	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)					A	A	Arc	Arc		
Renault (French)					A	Arc	A	Arc	A	Arc
Reo	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Roker	A	E	E	E						
Saxon	E	E	E	E	E	E	E	E	E	E
Selden	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (½ ton)			A	Arc						
Simplex			A	A	A	Arc	Arc	Arc	Arc	Arc
Stearns-Knight	B	A	A	A	B	A	B	A	B	A
" (8 cyl)	B	A	A	A	B	A				
Studebaker	A	Arc	A	Arc	A	Arc	Arc	Arc	A	Arc
Stutz	A	A	A	A	A	A	A	A	A	A
Velie (4 cyl)							A	Arc	A	Arc
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (2 & 3½ ton)	Arc	Arc								
" (½ ton)	A	Arc								
Westcott	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
White	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (16 valve)	A	A	A	A	A	A				
Willys-Knight	B	A	A	A	B	A	B	A	A	A
Willys Six	Arc	Arc	Arc	Arc						
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc

Electric Vehicles:—For motor bearings and enclosed chains use Gargoyle Mobiloil "A" the year 'round. For open chains and differential, use Gargoyle Mobiloil "C" the year 'round. Exception—For *winter lubrication* of passenger cars use Gargoyle Mobiloil "Arctic" for worm drive and Gargoyle Mobiloil "A" for bevel gear drive.

GMC Trucks Are Keeping Up The Supply of Motor Fuels



Today's Short Cut Between Supply and Demand

LIKE sentinels set to guard the source of supply, gaunt derricks dot the great oil fields; they mark the starting points of many transport trails that lead from producer to consumer.

From the well the pipe line leads to the refinery; the tank car and the marine tanker cover the next stage.

Next come the sturdy wheeled land fleets to cover the last lap of the journey—motor trucks, the true agents of distribution.

Supplanting horse-drawn equipment, motor trucks in small numbers have indeed grown to veritable fleets by virtue of their fitness for oil delivery.

And, now, with the greater impulse given to every agency contributing to the war program has come a decided impetus in the distribution of petroleum products.

GMC Trucks, both in government and industrial service, are doing their share toward providing more rapid and more dependable distribution of gasoline and kerosene for motor fuels.

GMC Trucks have helped build up a great traffic auxiliary to meet a pertinent need.

GMC Trucks are built to meet the severest demand of every emergency.

Every GMC is road tested.

Let Your Next Truck Be a GMC

GENERAL MOTORS TRUCK COMPANY

One of the Units of the General Motors Corporation

Pontiac, Michigan

Branches and Distributors in Principal Cities

DON'T WASTE GASOLINE

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GMC TRUCKS